ENERGY SAVINGS OPPORTUNITY SURVEY
FORT BELVOIR, ALEXANDRIA, VIRGINIA

A/E CONTRACT NO.
DACA 31-89-C-0198

FINAL SUBMITTAL

VOLUME I
Executive Summary

VOLUME II
Engineering Study

Prepared for

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND

By

ENGINEERING APPLICATIONS CONSULTANTS
9004-B CROWNWOOD COURT
BURKE, VIRGINIA 22015-1630

August 1991

DEPARTMENT OF THE ARMY
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VOLUME I

EXECUTIVE SUMMARY

1.0 INTRODUCTION

Fort Belvoir is a permanent United States Army installation located about fifteen miles south of Washington, D.C., in Fairfax County, Virginia. The facility consists of offices, research and training facilities, family housing and barracks.

The Energy Savings Opportunity Survey (ESOS) for Fort Belvoir is a project to improve energy efficiency of the buildings by analyzing selected energy conservation opportunities (ECOs) indicated in the scope of work and making recommendations for other ECOs which may be applicable.

This project is funded under the National Energy Conservation Policy Act (NECPA). ESOS projects have the prime objective of evaluating energy conservation opportunities (ECOs) in quest of meeting the goals of the NECPA, the Army Energy Plan and the Department of Defense Energy Management Plan.

This study constitutes the final submittal and includes the project criteria and the methodology used for conducting this analysis and programming documentation for selected projects. The study also includes an ECIP analysis summary for each ECO that was evaluated.

Engineering services for this project are being provided by Engineering Applications Consultants, P.C. under Contract No. DACA 31-89-C-0198 for the Department of the Army, Baltimore District Corps of Engineers.

Significant assistance and cooperation has been provided by the Corps of Engineers and the user agency for this analysis. EAC wishes to extend special appreciation to Mr. James Hawk for his cooperation and guidance, which has contributed to the development of this study.

2.0 PROJECT SUMMARY AND RECOMMENDATIONS

This study contains the findings of the Energy Savings Opportunity Survey at Fort Belvior, Virginia, and is based on the field survey, discussions with the users and the operating personnel and the review of drawings whenever available. Volumes I and II of this study contain the project criteria, methodology, building narrative and programming documentation. Volumes III and IV contain calculations and back-up data.

The project criteria lists environmental conditions within the buildings and climatic data applicable to the project site. Included under project criteria are fuel rates, incentives offered by Virginia Power for implementing energy conservation opportunities, economic life of the improvements and discount factors.

The methodology section of this study contains a description of energy saving opportunities considered under this survey and the procedures for calculating the energy savings. The recommended ECO's have been prioritized by taking synergism into account.

Ten buildings in the Belvoir Research Development and Engineering Center (building series 300) were analyzed for summer steam usage. These buildings use steam during summer for the re-heat type air conditioning system and for the domestic hot water system. Of the four alternatives considered, individual low pressure steam boilers located in each builiding for summer use had the highest SIR of 11.6 and the quickest payback of 2.1 years at a cost of approximately $575,000, exclusive of design cost. This ECO is recommended for implementation based on the ECIP analysis and is estimated to save 30,459 Mbtu and $192,150 annually.

The Control Tower (Building 1359) at Davison Air Field is over forty years old. The building has a poor envelope and its heating and cooling system provides poor environmental conditions for the occupants. The operation of the building's heating and cooling system was modeled using a computer program. A number of ECOs were analyzed by taking into consideration the

interaction of the ECOs. The following ECOs are recommended for implementation with synergistic effects accounted for.

ECO	COST	SIR	PAYBACK
Radiator Control Valves	$ 945	3.3	3.7 Yr.
Ceiling Insulation	$ 530	3.2	4.7 Yr.
Weather Stripping	$ 723	1.7	2.5 Yr.
Night Setback	$1,188	1.4	7.5 Yr.
Reflectors	$ 768	1.3	6.2 Yr.

The implementation of these ECOs at a total cost of $4,154 will result in savings of $700 per year.

Insulating of the exterior walls was also evaluated for Building 1359, although economically not feasible, it is recommended for implementation with the objective of improving the comfort of the occupants. The installation of the insulation will improve the performance of the heating and cooling system by providing a sealed envelope as well as increasing the useful life of the building.

The installation of a diesel or gas generator at Substation 505A was analyzed for peak shaving of electric demand and participation in standby generation program with Virginia Power. None

of the options meets the ECIP non-energy qualification test, or the payback criteria of other non-ECIP programs.

General Officers' Quarters, Dogue Creek Housing, and Rossell Village currently have oil heat. General Officers' Quarters and Rossell Village also have oil-fired domestic hot water heaters, while Dogue Creek, has electric water heaters. Woodlawn Village currently has electric heat pumps and electric water heaters. All of the above housing units have been evaluated for conversion to gas.

Northern Virginia Gas has agreed in priciple to install exterior gas distribution piping at no cost to the Government. The Government and the gas company should conclude negotiations for the extension of the gas lines. The analysis includes cost of curb to housing unit gas lines to the Government. Conversion to gas is economically feasible for Dogue Creek Housing and is recommended for implementation based on ECIP analysis.

Housing Area	Cost W\SIOH	Energy Saved Total (MBTU)	SIR	Payback
Dogue Creek	$205,446	-23	3.84	2.9

For Dogue Creek it has been assumed that the conversion can be implemented in conjuction with Project No. 24566, the design of which is underway by the Norfolk District Corps of Engineers. This conveersion will result in savings of $73,160 per year. The fuel conversion in other housing areas is not feasible for they were evaluated as "stand alone" projects.

As a part of this project, a number of buildings were surveyed for other potential ECO's. These ECO's are not included in the Scope of Work for this survey for evaluation. However, the following ECOs are recommended for further consideration for the 300 area buildings. These ECOs are likely to result in a substantial energy savings to the post.

- Install missing pipe and equipment insulation in the buildings identified in the narrative.
- Evaluate the air distribution system for reducing outside air and supply air.
- Evaluate the installation of night setback and heating water temperature reset.
- Lower the temperature of domestic hot water.
- Evaluate the reset of multi-zone unit hot deck temperature.
- Evaluate lighting in selected buildings for energy related retrofit.

3.0 BUILDINGS' DESCRIPTION

The scope of work of this Energy Savings Opportunity Survey includes the following buildings:

307, 309, 317, 327, 331, 334,
357, 362, 363, 365, 505A, 1359

All buildings in the 300 series are of brick masonry construction. They range in area from approximately 16,500 square feet each in buildings 317 and 334 to about 64,100 square feet in building 331. The buildings' usage includes, but is not limited to, combinations of office areas, laboratories and workshops. Building 505A is an electrical substation serving 0-99, 200, 400 and 500 areas. Building 1359 is the Aircraft Control Tower at the Davison Army Airfield and is a seven level steel structure with metal panel walls. It has a gross area of 2,870 square feet. All the buildings, except 505A, are heated and cooled. Cooling requirements are met by packaged chillers in each building. Some buildings have DX systems and roof-top packaged units. Heating and service hot water requirements of buildings are generally met by reducing the high pressure steam from the building 332 central plant. Lighting is mostly fluorescent.

In addition, the following housing areas are also included for study of fuel conversion:

General Officers' Quarters (59 units)	Buildings 1-19, 21-60
Rossell Village (30 buildings, 60 units)	Buildings 401-419, 421, 423-432
Dogue Creek (45 buildings, 270 units)	Buildings 900-944
Woodlawn Village (143 buildings, 444 units)	Buildings 2600-2608, 2610-2656, 2660-2688, 2700-2708, 2710-2720, 2730-2740, 2750-2761, 2770-2776, 2780-2787)

The General Officers' quarters have oil-fired steam boilers and hot water heaters, whereas Rossell Village units have oil-fired hot water boilers and hot water heaters. The Dogue Creek housing units have oil-fired warm air furnaces and Woodlawn Village area has electric heat pumps. Both areas have electric water heaters.

4.0 ENERGY CONSUMPTION

4.1 Annual Energy Used

An analysis for an energy conservation project requires determination of existing energy-usage pattern. However, in the absence of any individual metering and due to a limited scope of the project, the following baseline energy consumption has been established **only for the affected systems** in the respective buildings.

PRESENT ENERGY USAGE

Buildings	MBTU/Yr
300 Area	97,222
900-944 (Dogue Creek)	16,340
1359 (Control Tower)	470
TOTAL	114,032

4.2 Source Energy Used

The following table summarizes the baseline energy consumption:

FUEL	SITE ENERGY MBTU/YR	SOURCE ENERGY MBTU/YR	COST $/YR
Electricity	5,364	5,364*	96,938+
Residual Fuel Oil	96,063	128,724**	894,475
Distillate Oil	12,605	12,605	93,655
Total	114,032	146,693	1,085,068

* Based on ECIP guidance of 25 April 1988 (Purchased Electric Power)

** Based on site energy conversion of 1,000 btu/lb. (TM 5-838-2) and source energy conversion of 1,340 btu/lb. (ECIP guidance)

+ Includes demand charges

5.0 ENERGY CONSERVATION ANALYSIS

5.1 Energy Conservation Opportunities (ECOs) Investigated

The energy conservation opportunities for each building are identified in the Scope of Work for this project. These opportunities are discussed below.

Summer Steam Evaluation

The objective of this evaluation is to investigate the economic feasibility of providing the buildings listed with an alternate source of steam during the non-heating months. These buildings are 307, 309, 317, 327, 331, 334, 357, 362, 363, and 365 in the Belvoir Research, Development and Engineering Center. Four alternatives have been considered, as follows:

1. Install a new boiler at the central heating plant #332 to handle only the summer load allowing the large boiler to be shut down.

2. Install a new boiler at each building for summer load allowing central heating plant #332 to be shut down.

3. Install a new steam and condensate main, sized for summer load, from the central heating plant #1422 to the 300 area distribution system allowing the central plant #332 to be shut down.

4. Install a new steam and condensate main, sized for year-round load, from the central heating plant #1422 to the 300 area allowing the central plant #332 to be permanently closed.

Peak-Shaving Generators

The purpose of this analysis is to evaluate the feasibility of using a diesel generator to shave off electric demand and thus reduce demand charges year round. The diesel generator will be installed at the site of the existing Substation 505 A. Two options were conceptualized for analysis for using the generator.

Option A: Peak Shaving - Use generator during on-peak hours to reduce electrical demand.

Option B: Standby Generators - Participate in Virginia Power Standby Generator Program, under rate schedule MSSG.

Computer Model

The Aircraft Control Tower at the Davison Army Airfield, Building 1359, was targeted for computer modelling for its enegy usage and energy savings from the energy conservation opportunities (ECOs) to be identified. The following ECOs were identified and investigated.

1. Wall Insulation

It is proposed to add 2" wall insulation (R-11) by installing an exterior wall insulation system to improve the U-value for the wall assembly from 0.4 to 0.074 Btu/hr-SF-°F.

2. Roof/Ceiling Insulation

Six inches of batt insulation will be installed above the suspended ceiling to provide additional R-19 insulation. The U-value will improve from 0.22 to 0.0425 Btu/hr-SF-°F.

3. Replace Single Glazed Windows with Double Glazed Windows

Most of the existing windows in this building are single-glazed. These windows will be replaced with double-glazed windows, which will improve the fenestration characteristics, namely U-value from 1.0 to 0.58 and glass factor from 1.0 to 0.9.

4. Weatherstripping

It is assumed that weatherstripping will plug the cracks and gaps and reduce infiltration into the building.

5. Night Setback

The building does not have any night setback controls. Under this ECO, time clock controls will be provided for the HVAC systems to save energy during the unoccupied period.

6. Radiator/Unit Heat Control Valves

Free flow of steam in the radiator and unit heater causes overheating. Control valves are proposed to cut-off steam when a preset temperature (68°F.) is reached.

7. Reflectors

The fluorescent light fixtures on the third floor are open type fixtures. It is proposed to install reflectors to generate savings in lighting and cooling costs. However, heating costs will increase by a small margin.

8. Occupancy Sensor

Lights in the conference room on the sixth floor stay on for a large period of time. An occupancy sensor will turn the lights off when not required. Installation of reflectors will result in energy savings in lighting and cooling but will result in marginal increases in heating energy.

Fuel Conversion

The investigation focussed on conversion of existing fuel, oil or electricity, to natual gas for heating and service hot water needs in the 833 residential units in the following housing areas.

	Existing	Proposed
General Officers'Quarters (59 units)	Oil-fired boilers & water heaters	Gas-fired boilers and water heaters
Rossell Village (60 units)	Oil-fired boilers and water heaters	Gas-fired boilers and water heaters
Dogue Creek (270 units)	Oil-fired furnaces & electric water heaters	Gas-fired furnaces and water heaters
Woodlawn Village (444 units)	Heat pumps and electric water heaters	Gas-fired furnaces and water heaters.

The conversion to gas-fired equipment involves extending new gas lines to these areas.

5.2 Recommended ECOs

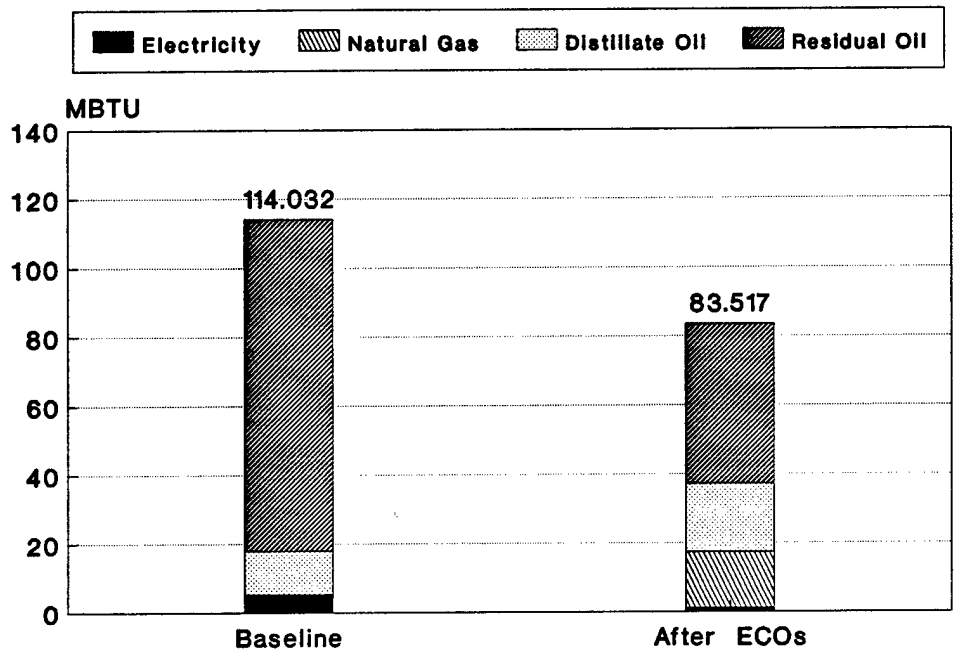
The feasibility of each ECO was determined on the basis of energy savings calculations (taking into account synergistic effects), investment cost estimates, and life cycle cost analysis. Savings to investment ratio (SIR) of unity, or greater, for an ECO qualifies it for implementation.

6.0 ENERGY AND COST SAVINGS

The following table presents the estimated energy usage patterns and costs before and after the implementation of the recommended ECOs.

	Existing Energy & Cost	Energy and Cost After Implementation of ECOs	Savings After Implementation	
			%	Savings
Site Energy Consumption				
Electricity Mbtu	5,364	1,097	79.5	4,267
Natural Gas Mbtu	---	16,308		(16,308)
Distillate Fuel Oil Mbtu	12,605	19,702	(56)	(7,097)
Residual Fuel Oil, Mbtu	96,063	46,410	51.7	49,653
Total Mbtu	114,032	83,517	26.7	30,515
Source Energy Consumption				
Total Mbtu	146,693	99,296	30.2	47,397
Energy Costs				
Per/year	$1,085,068	$652,662	39.4	$432,906

Energy Usage by Fuel



7.0 ENERGY PLAN

The following categories of programs are available for the recommended ECOs:

Energy Conservation Investment Program (ECIP); This program is for projects which have a construction cost estimate greater than $200,000, a savings to investment ratio (SIR) greater than one and a simple payback period of eight years or less.

Productivity Capital Investment Programs (PCIP): The projects that do not qualify for ECIP fall into the category of Productivity Capital Investment Programs (PCIP). The following categories of PCIP programs are available for the recommended ECOs:

1. Quick Return in Investment Program (QRIP): This program is for projects which have a total cost of less than $100,000 and a simple payback period of two years or less. Three year procurement (AMMO and OPA) appropriations are available for this program.

2. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a cost greater that $100,000 and a simple payback period of four years or less. Projects under this program must be pre-identified two fiscal years in advance.

3. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a cost greater that $100,000 and simple payback period of four years or less. The projects under this program require MCA funding. Because of the difficulty in obtaining MCA funding, implementation under this program has not been considered.

Considering the availability of the above programs, the following packages have been prepared.

ECIP - Installation of oil-fired boilers and water heaters in the 300 area will qualify under this program as under:

ECO Description	Cost (Incl. SIOH) FY 1991	Program Year 1993
Install oil-fired boilers in buildings 307, 309, 317, 327, 331, 357, 362, and 363 and water heaters in buildings 334 and 365	$575,562	$600,291

The annual savings will be 30,459 Mbtu and a cost savings of $192,500.

PECIP - Replacement of oil-fired furnaces and electric water heaters with gas-fired furnaces and water heaters in the 900 area (Dogue Creek) will qualify under this program.

ECO Description	Cost (Incl. SIOH) FY 1991	Program Year 1993
Replace oil-fired furnaces and electric water heaters with gas-fired furnaces and domestic water heaters in 270 housing units in the 900 area (Dogue Creek).	$205,446	$214,280

The annual energy savings will be negative, but due to the change in fuel, the cost savings will be $73,150 per year.

Low Cost Projects - The energy conservation opportunities (ECOs) determined feasible for Building 1359 (Control Tower) maybe implemented at low cost.

ECO Description	Cost (incl. SIOH)
Install radiator control valves, ceiling insulation, weatherstripping, night set-back controls, and fixture reflectors in Building 1359.	$4,154

The energy savings will be 79 Mbtu and $700 annually.

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8.0 PROJECT CRITERIA

The analyses of the building energy usage and the estimated reduction in the energy usage due to the implementation of the proposed energy conservation opportunities are based on the criteria set forth here.

8.1 Outdoor Conditions

Based on publication TM 5-785, Engineering Weather Data, the following outdoor conditions have been assumed:

Summer	90° F DB/75° WB
Winter	12° F

8.2 Indoor Conditions

The indoor conditions have been selected, following the guidelines of MIL-HDBK-1190, Facility Planning and Design Guide, based on primary activity within a building. The indoor temperatures have been assumed as under:

Summer	75° F DB
Winter	68° F DB

The hours of operation and occupancy levels are based on information obtained from the Post and data collected during field visits to various buildings.

8.3 Fuel Rates

Fuel rates used for the analysis were obtained from the Fort Belvoir Facilities Division and utility companies and are included in Appendix B.

8.3.1 Electricity

For electricity, Virginia Power's Schedule MS for Federal Government installations has been used, with the additional input of -$0.00093/KWH as fuel adjustment factor (effective since April, 1990). For Federal Government installations, Virginia Power also offers an incentive program, Schedule MSSG. This program provides credit for on-site generation of electric power when requested by the power company. The credit is $6.00/month for each kW of applicable generation. The participant is notified no less than four hours prior to the requested generator operation. The operation of generators is not required more than once per day, 125 hours per season or 200 hours per year.

8.3.2 Natural Gas

The natural gas rates used in the calculations are based on the average cost at Fort Belvoir. The gas is supplied by Northern Virginia Gas at a rate of $0.5329/therm. This rate was provided by the base Facilities Division.

8.3.3 Other Rates

Based on the recent data available from the facility, the following factors have been used for calculations:

Data		Factor	Source
Rate Charged by Central Plant	=	$9.97/1000 lb. of steam	Base Facilities
Site Energy Conversion Factor	=	1,000 btu/lb. of steam	TM 5-838-2
Source Energy Conversion Factor	=	1,340 btu/lb. of steam	ECIP Guidance

Data		Factor	Source
Distilled Oil (#2)	=	$1.03/gallon	Base Facilities
Residual Oil (#5 oil)	=	$0.99/gallon	Base Facilities

8.4 Economic Life

As stipulated in the Energy Conservation Investment Program (ECIP) guidelines, economic lives have been based on the lesser of 25 years or the useful life of the ECO. The remaining lives of the buildings are assumed to exceed 25 years. The useful lives of ECOs are based on ECIP guidelines and ASHRAE 1991, HVAC Applications.

8.5 Discount Factors

The Uniform Present Worth (UPW) factors published for Region 3 by the Department of Energy (DOE) under the Federal Energy Management Program (FEMP) have been used in accordance with the guidance for the Energy Engineering Analysis Program (EEAP).

9.0 METHODOLOGY

9.1 Data Collection and Correlation

A great deal of emphasis was placed upon gathering data for the energy consuming systems of the buildings and their operating characteristics.

9.1.1 Drawings and Other Documents

An earnest effort was made to locate drawings, specifications, shop drawings, cut-sheets and any other documents which could provide information regarding the existing equipment, buildings' operating characteristics and operating procedures. Also, data for operating hours and occupancies was requested from the Fort Belvoir Facilities Division; and, with its help, maintenance and operating personnel were interviewed to arrive at a realistic understanding of the buildings' systems.

9.1.2 Field Surveys

Engineering teams were organized to conduct field surveys. The team members were well prepared for this work by in-office study of drawings and other documents and briefing by the team leader before starting the field work. Suitable forms for field data were prepared to make sure that comprehensive data was collected efficiently and that there was no unnecessary interruption of the occupants' work. The surveys covered building envelope, building operation, occupancies and energy-consuming items like computers, appliances, lighting and mechanical systems. Whenever possible, the survey teams took the opportunity to discuss with the occupants the working characteristics of their respective areas.

This data was collated and checked for any deficiencies or discrepancies and was corrected either by checking drawings, by further discussions with the operating personnel, or by additional field visits.

9.2 Computer Simulation

The calculation of energy consumption, where required, was obtained by computer simulation using E20-II. E20-II, Hourly Analysis Program (HAP) has been developed by Carrier Corporation. As its name implies, the program performs hourly calculations based on weather data. As with any such program, to obtain a reasonably accurate simulation, certain assumptions were made to adapt the field data for program input. Some of the assumptions were general, while others were specific to each building.

General Assumptions

The following general assumptions were made for all buildings where computer simulation was used:

- U-values for the walls and roof systems were either calculated from data collected in the field, or from information on the drawings.
- Holidays were considered to have the same characteristic loads as Sundays.
- Schedules for various loads like lighting, people, and heat producing equipment were based on field observations, interviews with operating personnel and common practice in the industry.
- Plant data has been obtained from field observations and manufacturer's catalogs.
- Ventilation data, supply air temperatures and other data have been obtained from drawings and adjusted for each building as necessary.
- Based on the interviews with operating personnel and field observations, none of the buildings have night set-back in operation.

- Indoor design temperatures are based on MIL-HDBK-1190.

- Outdoor design temperatures are based on TM5-785 as under:

  Summer: 90° F DB/75° F, WB
  Winter: 12° F DB

- The infiltration rate has been calculated based on ASHRAE 1989.

- The cooling kW/ton for each system has been obtained from manufacturer's catalogs and, in case of non-availability, is based on ASHRAE guidelines.

9.3 Summer Steam Use Evaluation

Certain buildings in the Belvoir Research, Development and Engineering Center require summer steam for air conditioning reheat and domestic hot water generation.

The objective of this evaluation is to investigate the economic feasibility of providing these buildings with an alternate source of steam during the non-heating months. The buildings considered for evaluation of summer steam requirements are 307, 309, 317, 327, 331, 334, 357, 362, 363, and 365.

As indicated earlier, all available drawings were acquired and studied, followed by field visits to verify and update this information as to actual conditions, equipment, usage, occupancy, schedule of operation, etc. The compiled information was then used as input for the E20-II Hourly Analysis Program providing a simulation of baseline energy consumption for air conditioning reheat and domestic hot water systems in each of the ten buildings. Additional information was collected regarding the central heating plants at Buildings 332 and 1422. Facilities engineering operating logs were obtained indicating actual steam produced and fuel oil and makeup water expended on a daily basis. This, in turn, provides the actual plant efficiency.

Four alternatives have been considered, as follows:

1. Install a new boiler at the central heating plant #332 to handle only the summer load allowing the large boiler to be shut down.

2. Install a new boiler at each building for summer load allowing central heating plant #332 to be shut down during summer.

3. Install a new steam and condensate main, sized for summer load, from the central heating plant #1422 to the 300 area distribution system allowing the central plant #332 to be shut down.

4. Install a new steam and condensate main, sized for year-round load, from the central heating plant #1422 to the 300 area allowing the central plant #332 to be permanently closed.

Discussions with the base facilities personnel indicated that although summer-winter system changeover was on a building by building basis, generally this occurred about April 15th and October 15th.

The first three alternatives allow the central heating plant, Building 332 to be out of operation from mid-April through mid-October, while the fourth alternative will allow the central plant in Building 332 to be permanently closed.

The savings in around-the-clock expenses of operating personnel, fuel, electricity, etc., were compared with the initial investment, energy usage, maintenance, and custodial costs of each ECO with the engineering analysis program to determine qualification with ECIP guidelines.

9.4 Peak Shaving Generators

The purpose of this analysis is to evaluate the feasibility of using diesel or gas generators to shave off electric demand and thus reduce demand charges year round. The generator will be installed at the site of the existing Substation 505 A. Two options were conceptualized for analysis for using the generator.

Option A: Peak Shaving - Use generator during on-peak hours to reduce electrical demand.

Option B: Standby Generators - Participate in Virginia Power Standby Generator Program under rate schedule MSSG.

Each option is discussed separately since implementation of one precludes the implementation of the other.

Option A: Peak Shaving

This option involves the installation of a diesel generator to be used during periods of high on-peak electrical demand. The generator will be located at the site of Substation 505 A and would reduce electrical load by controlling one or more of the circuits at Substation 505 A.

It is important to note that changes in demand load at Substation 505 A do not necessarily coincide with the electrical demand load for the overall peak at Fort Belvoir. Therefore, any changes in demand load for Substation 505A shall be made with the objective of impacting the overall electrical peak demand for the entire post.

Option B: Standby Generator

This option will require Fort Belvoir's participation in Virginia Power's standby generation program under Schedule MSSG for Federal Government Installations (Appendix B). This program allows a monthly credit of $6.00 per kW of average capacity generated per month. This program will provide the post with more flexibility, since the generators do not have to run every day, but are required to be available and ready to run at no less than 4 hours notice. In addition, the operation of the generators will be limited to a maximum of 200 hours per year, 125 hours per season and only once per day.

9.5 Fuel Conversion

The following residential buildings have been analyzed for conversion to gas-fired heating equipment:

	Existing	Proposed
Quarters 1 through 60	Oil-fired boilers & water heaters	Gas-fired boilers and water heaters
400 area (Rossell Village)	Oil-fired boilers and water heaters	Gas-fired boilers and water heaters
900 area (Dogue Creek)	Oil-fired furnaces & electric water heaters	Gas-fired furnaces and water heaters
2600 area (Woodlawn Village)	Heat pumps and electric water heaters	Gas-fired furnaces and water heaters.

The conversion to gas-fired equipment involves extending new gas lines to these areas. Energy usage by the existing system and proposed systems, has been simulated by utilizing Carrier's Hourly Analysis Program (HAP). The proposed systems are assumed to be equivalent is capacity to the existing systems.

For the purpose of ECIP analysis, the simulated energy usage for the existing systems has been input as energy savings and energy usage for the proposed systems as the energy expended. Other assumptions are as follows:

- The useful life of equipment is:

Residential Boiler	20 Years
Furnaces and Heat Pumps	15 Years
Water Heaters	10 Years

- Since the ECOs consist of the replacement of water heater and boiler/furnace, which have different economic lives, the water heater will be replaced again during the life of the ECOs.

EAC has had discussions with the gas company on bearing the costs of installing gas lines to the areas mentioned above. The gas company has agreed, in principle, to do so. The evaluation analysis includes cost to the Government for curb to the housing unit gas line only.

10.0 BUILDING NARRATIVE

10.1 Building 307

10.1.1 Building Description

General: Building 307 is a 32 foot high brick and block structure with steel frame and built-up roof over rigid insulation on steel deck. The building consists of two full stories with a 4-1/2 foot clear interstitial utility space between the floors. The building has a gross area of approximately 19,000 square feet. The building houses laboratories and offices for 43 employees.

HVAC: The building receives high pressure steam from the central plant at building 332, which is reduced lower pressure to serve two shell and tube steam to hot water converters for heating. Cooling medium is chilled water provided by packaged water chilling equipment located outside of the mechanical room. Three main air handling units serve the entire facility with conditioned air which is reheated. Laboratory areas are provided with individual room reheat coils, small heating and ventilating units provide make-up air to fume hoods and the building has a perimeter radiation system. Each air handling system has a return air fan and the building has many small exhaust fans.

Domestic Hot Water: Domestic hot water is being provided by a steam to hot water generator located in the mechanical room. The steam control valve is capable of supplying 105 lbs/hr @ 5 psig.

10.1.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in Paragraph 10.17, Summer Steam Use Evaluation.

10.1.3 Potential ECOs

1. Repair or Replace Steam Trap

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since some uncondensed steam is returned, not all of the heat is utilized in the building. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and reheat traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required. During the survey, it was found that the steam trap on the domestic hot water tank is not operating correctly; it may have partially failed or may be improperly sized.

2. Reduce Outside Air

According to the mechanical systems drawings, a minimum of 8,380 cfm of outside air is provided to the lab. The quantity of outside air was based on the exhaust air from fume hoods and other exhaust fans. The ASHRAE 62-1989 requirement for offices and labs is 20 cfm per person. Typically, lab fume hoods exhaust much larger quantities of air than the minimum required by ASHRAE. Since the estimated number of persons in the lab is 43, the minimum total outside air quantity of 860 cfm is requested. Based on available data from the drawings and site inspection, fume hood and miscellaneous exhaust fans remove 17,270 cfm; about 400 cfm per person. However, all but one of the fume hoods were off during the site visit. In addition, most of the makeup air for the fume hoods is supplied by separate H&V units. Therefore, it is recommended that the minimum outside air volume from the three air handling units be reduced. The quantity of air supplied to each room with a fume hood should ensure that a negative room pressure is maintained to minimize the spread of contaminants throughout the remainder of the building. Similarly, offices and other common areas should be under positive pressure to minimize the likelihood of contaminants entering the rooms.

To implement this ECO, new dampers and damper controls will be required. The air-handling and distribution system will have to be carefully rebalanced to ensure proper pressurization in each room. The controls installed should complement the use of an economizer air control system and variable air volume or two speed fans. Additional changes to the return air system may also be required to balance the building ventilation system.

3. Reduce Supply Air

The quantity of conditioned air supplied to the occupied areas must be sufficient to heat or cool the space and to ensure the rooms do not feel stuffy. According to the mechanical system drawings, approximately 20,000 cfm is supplied to the building. This does not include the clean room area. There is no indication that AHU #1, #2, or #3 were resheaved during the many renovations of the building. About one cfm per square foot should be adequate to provide proper cooling and heating if the ventilation system is balanced. The supply air quantity may be reduced by incorporating a variable air volume system or by using two speed fans. The volume of air specified in the design drawings can be reduced by about 30 per cent, thereby reducing the fan energy needed to supply air to the building. Fan energy savings may be reduced by as much as 50 per cent.

4. Shut Off Equipment During Unoccupied Periods

A review of the lab operation and temperature requirements should be performed to determine if it is possible to shut down one or more of the central systems for the building during unoccupied periods. The use of low and high limit thermostats will be required and should likely be adjusted to take into account the environmental requirements of the lab areas.

Time clocks or an EMS controller (there is an EMCS control cabinet in the mechanical room) should shut down all applicable fans, pumps, and chillers. The savings from this ECO will result from reduced heat transfer through the building envelope, reduced ventilation load and the reduction in equipment operation.

An override mechanism should be included to ensure that personnel in the building during non-duty hours can get the necessary heating or cooling. This will require either a switch or an EMS operator phone that is accessible to all personnel.

5. Warm Up and Cool Down Controls

In conjunction with shutting off the heating and cooling systems, the use of zero leakage dampers is recommended. While the HVAC system is bringing the building back to normal operating conditions, the need to heat or cool outside air is unnecessary. By installing low leakage outside air dampers and controls, only the return air in the building needs to be tempered. This ECO could also be implemented in conjunction with an economizer or control system to ensure cool air purging is used rather than using a chiller to bring the temperature down to operating conditions.

6. Economizer Control

The installation of an economizer control system would reduce the cooling requirements on the building. By using relatively cool outside air rather than having to cool warmer return air, the chiller may be shut off or the load reduced.

7. Install Setback Thermostats on Individual Zones

If it is determined that the lab requirements override the ability to shut down the air-handling units, the use of individual zone setback thermostats can reduce energy usage in "non-critical" areas. Thus, office areas can have the zone reheat valves operate on a setback thermostat while labs operate under 24 hour operating conditions.

8. Zone Optimization for Reheat System

Zone reheat systems typically use a fixed cold deck temperature and apply thermostatic controls to operate reheat coils to maintain comfort in each zone. If every zone is reheating, the cold deck is too cool and the load on the chiller can be reduced. The site visit to the building was made when it was cool outside and it wa found that the chillers were operating. There was no indication that optimization controls were being used. By installing optimization controls, the cold deck can be reset to a higher temperature to a higher temperature to minimize the amount of cooling and heating required. Higher cold deck temperature requires less cooling and higher supply air temperature requires less reheating to maintain proper comfort.

9. Variable Air Volume Systems

Terminal reheat systems generally represent excellent opportunities for replacement with VAV systems. By varying the quantity of air supplied to the occupied space, proper cooling is provided. Based on the volume of the air supplied to the building, the quantity of supply is adjusted. As the load decreases, the quantity of air supplied decreases and the fan energy usage is reduced.

Two items should be considered prior to the implementation of this ECO. First, ensure that minimum outside air requirements are met. Second, ensure that adequate provisions for heating are incorporated into the design.

10. Reset Space Temperature and Humidity

The building does not seem to require strict temperature and humidity control with the exception of a few lab areas. Space temperature can be controlled over a wider range by the use of dead band thermostats. By allowing the space conditions to vary over a larger comfort range, the energy requirements are reduced. Consequently, this reduces both chiller and reheat loads. This ECO should be performed in conjunction with the zone setback ECO.

11. Two Speed Motors

The existing ventilation system was designed to provide adequate outside air for a lab with numerous fume hoods. With the present usage of the building, the supply air and outside air quantities are in excess of normal office requirements. In addition, when the existing fume hoods are turned off (as they were found during the site visit), a large amount of fume hood makeup air is not required. Replacement of existing motors with two speed motors as an alternative to the variable speed drive option noted above should also be considered. When fume hood exhaust reaches a specified level, the higher speed would be used. Under most conditions, the lower speed would be more than adequate. The reduced fan speed saves fan motor energy and the cost od conditioning of the outside air.

It should be noted that the current ventilation system has supplementary H&V units to provide makeup air for the fume hoods. Air supplied by these systems must be taken into account when designing a new system.

12. Install High Efficiency Motors

It is recommended that the existing large motors be replaced with high efficiency motors. The evaluation for replacement should be based on the annual hours of operation and the size of the motor. For the motors located in building 307, if the existing system operation remains unchanged (i.e.; no night shut down), it is likely that a life cycle cost analysis will direct the immediate replacement of the motors. If the hours of operation are reduced or the fans resheaved, the energy cost savings will be decreased. Under these conditions, it is recommended that new motors be replaced with high efficiency motors at failure or during air handling system upgrade.

13. Raise Evaporator (Chilled Water) Temperature

During the site visit, the maintenance staff indicated that chilled water is set at a constant temperature. As the cooling load is reduced from design conditions, the chilled water is not reset to compensate for reduced cooling requirements. Since line losses are greater for lower chilled water temperature as well as the chillers run less efficiently at lower chilled water temperatures, a chilled water temperature reset controller would improve energy efficiency. Chilled water temperature should be reset based on ambient conditions or load.

14. Outside Air Reset

A hot water convertor is used for the reheat system. Based on the mechanical drawings and site inspection, an outside air reset system has not been installed. The water temperature during the site visit was 145° F. even though the outside temperature was about 50° F. During milder periods of the heating season, this causes overheating and unnecessary line losses. It is recommended that an outside air reset controller be installed on the hot water convertor. The hot water temperature should be set in accordance with the ambient air temperature.

15. Install Valve Insulation

Uninsulated steam and condensate return valves allow heat to be wasted. The heat from bare surfaces warms the unoccupied mechanical room rather than providing heat to the preheat, hot water convertor, or DHW tanks. During the survey, it was noted that at least 10 valves in the mechanical room were not insulated.

16. Caulking

Caulking around the windows should be evaluated.

17. Lighting ECOs

During a spot check in this building, illumination levels in excess of Army guidelines were found in hallways (40-50 footcandles) and in work areas (100-120 footcandles). However, in the hallways, where only every other fixture was turned on, economizing efforts were evident. The following items appear to have potential for energy savings in this area.

Delamping: Most fluorescent fixtures have four lamps. Where lighting levels permit, consideration should be given to removing two of the four lamps and disconnecting one ballast in such fluorescent fixtures.

Photo-electric Dimming: Rooms that have large amounts of sunlight are good prospects for photo-electric dimming. Economic feasibility of installing photo-electric dimmers in such rooms, which have high illumination levels, should be evaluated. Rooms 106, 107, 108, and 120 are some examples.

Static Dimming: For those rooms that do not have windows, but have high illumination levels, static dimmers should be considered.

Reflectors: In some areas, such as the lab rooms, the installation of reflectors would reduce energy usage, while providing adequate lighting levels.

Occupancy Sensors: Many of the rooms checked were vacant, but the lights were turned on. The feasibility of installing either ceiling-mounted or switch replacement occupancy sensors should be examined.

Screw-In Fluorescent Lamps: Incandescent lamps, such as in room 117, should be replaced with screw-in fluorescent lamps.

Switching: In rooms, such as room 128, the switching arrangement should be checked and, if necessary, re-wired for additional flexibility.

10.2 Building 309

10.2.1 Building Description

General: Building 309 is a reinforced concrete structure with precast concrete double tee subflooring under three inch concrete fill. Exterior walls are face brick and block with cavity with some architectural stone fascia. Roof over lab and office area is built-up type with two inch rigid insulation over 3-1/2" of concrete fill and precast double tees. Roof over the simulator chamber is also built-up type with two inch rigid insulation over 1-1/2" metal deck and steel joists.

The lab and office area consists of two floors and a five foot clear utility space in between with cement-asbestos faced fiberboard floor panels. Windows are single glazed, metal framed with 3/4 inch air space and single glazed storm panels.

The simulation chamber is a fan shaped forty-five foot high structure with no windows and a forty foot ceiling height.

The building has a gross area of 36,500 square feet.

HVAC: Building 309 is served high pressure steam from the central plant in Building 332, which is reduced to low pressure in the mechanical equipment room to serve air handling unit heating coils, heating hot water convertor and domestic hot water generator. Building cooling is provided by two 90 ton packaged hermetic reciprocating liquid chillers supplying chilled water to air handling unit coils.

The building's primary heating ventilating and air conditioning requirements are met by four draw thru air handling systems. The air handling unit serving the office area is a multi-zone type with standard configuration. The unit serving the laboratory areas has a preheat and a

cooling coil with individual room reheat coils, and the units serving the computer areas and the simulator chamber are also capable of reheat.

NOTE: The AHU designation numbers used in the computer simulation are based on the design drawings and may not match unit numbers in the field, e.g. office multi-zone AHU is AHU-1 in the design documents and AHU-3 in the field.

Domestic Hot Water: Domestic hot water is produced by a low pressure steam to hot water generator located in the mechanical equipment room. The generator is vertical type with 184 gallon capacity. It has a two inch LP steam supply through a 3/4" control valve.

10.2.2 ECOs Investigated

The steam usage curing summer has been evaluated for this building based on the methodology described in Paragraph 9.3. The results of this evaluation are given in Paragraph 10.17, Summer Steam Use Evaluation.

10.2.3 Potential ECOs

1. Install Pipe and Valve Insulation

Uninsulated steam and condensate return lines allow heat to be ineffectively used. The heat from uninsulated surfaces warms the unoccupied mechanical room rather than providing heat to the preheat or reheat coils. Small sections of insulation were found to be missing on the pipes. These bare pipes should be insulated. In addition, ten (10) valves in the mechanical room were found that were not insulated. These valves should also be insulated.

2. Steam Trap Repair or Replacement

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. The heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and reheat traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

3. Reduce Outside Air

According to the mechanical system drawings, a minimum of 7,950 cfm of outside air is provided to the offices and lab areas, not including the simulation chamber. The quantity of outside air was based on the exhaust air from fume hoods and other exhaust fans. ASHRAE 62-1989 requirement for offices and labs is 20 cfm per person. Typically, lab fume hoods exhaust much larger quantities of air than the minimum required by ASHRAE.

Since the estimated number of persons in the lab is 87, the minimum total outside air quantity required is 1,740 cfm. Therefore, it is recommended that the minimum outside air volume from the two air handling units be reduced by about 6,000 cfm. To implement this ECO, new dampers and damper controls will be required. The systems will have to be carefully rebalanced to ensure proper pressurization in each room. The controls installed should complement the use of an economizer outside air control system and variable air volume or two speed fans. Other changes to the return air system may be required to balance the building ventilation system.

Although EAC personnel was not permitted into all rooms in the building during the site visit, it was noted that a large number of fume hoods had been removed. This was based on the rooms accessed and comments made by the maintenance personnel. However, if there are isolated fume hoods located in the building, the quantity of air supplied to each of those rooms should ensure that a negative room pressure is maintained to minimize the spread of contaminants throughout the remainder of the building. Similarly, offices and other common

areas should be under positive pressure to minimize the likelihood of contaminants entering the rooms.

4. Shut Off Equipment During Unoccupied Periods

Since the areas requiring strict temperature and humidity control have their own HVAC systems (computers and simulator rooms), it may be possible to shut down the AHU #1 and #2 during unoccupied periods. Time clocks or an EMS controller should shut down all applicable fans, pumps, and chillers. Savings will be achieved due to reduction in heat transfer, shut off of ventilation air and motors.

5. Warm Up and Cool Down Controls

In conjunction with shutting off the heating and cooling systems, EAC recommends the use of zero leakage dampers during building warm up in the winter and cool down in the summer as fresh air is not required during warm up or cool down cycles. Thus, while the HVAC system is bringing the building back to normal operating conditions, the need to heat or cool outside air is unnecessary. By installing low leakage outside air dampers and controls, only the existing air in the building needs to be tempered.

6. Economizer Control

The installation of an economizer control system would reduce the mechanical cooling requirements for the building. By using relatively cool outside air rather than having to cool warmer return air, the chiller may be shut off or the load reduced. When the economizer controls are added. dampers should also be replaced to improve system efficiency. The outside air openings may also have to be increased in size to accommodate the additional outside air volume. Similarly, return air system controls will have to be modified to coordinate the "purging" of inside air.

7. Zone Optimization for Reheat Systems

Zone reheat systems typically use a fixed cold deck temperature and apply thermostatic controls to operate reheat coils to maintain comfort in each zone. If every zone is reheating, the cold deck is too cool and the load on the chiller during that period can be reduced. EAC inspected the building on a cool day and found the chillers operating. There was no indication that the optimization controls were being used. By installing optimization controls, the cold deck is reset to a higher temperature to minimize the amount of cooling and heating required. Higher cold deck temperature requires less cooling and higher supply air temperature requires less reheating to maintain proper comfort. It should be noted that hot deck and cold deck optimization is indicated on the mechanical system drawings. However, based on field data, it is unlikely that this control system is currently affective.

8. Reset Space Temperature and Humidity

The entire building does not require strict temperature and humidity control. Therefore, space temperature can be controlled over a wider range by the use of dead band thermostats. By allowing the space conditions to vary over a larger comfort range, the energy requirements are reduced. Consequently, this reduces both chiller and reheat loads.

9. Install High Efficiency Motors

EAC recommends that the existing motors be replaced with high efficiency motors. The evaluation of the replacement should be based on the annual hours of operation and the size of the motor. For the motors located in this building, if the existing system operation remains unchanged (i.e.; no night shut down), it is likely that a life cycle cost analysis will direct the immediate replacement of the motors. New motors can also to be replaced with high efficiency motors at failure or during air handling system upgrade.

10. Raise Evaporator (Chilled Water) Temperature

Maintenance staff for the building indicated that chilled water temperature is set at a constant temperature. As the cooling load is reduced from design conditions, the chilled water temperature should be reset to compensate for reduced cooling requirements. Since line losses are greater for chilled water at lower temperature and the chillers also run less efficiently at lower chilled water temperature, a chilled water temperature reset controller would improve energy efficiency. Chiller water temperature should be reset based on ambient conditions and load on the building.

11. Outside Air Reset

A hot water convertor is used for booster coils, unit heaters, and convectors. Based on the mechanical drawings and site inspection, an outside air reset system has not been installed. The range on the mechanical plans for heating hot water was 160° F. to 180° F. During milder periods of the heating season, this causes overheating and unnecessary line losses.

It is recommended that an outside air reset controller be installed on the hot water convertor. The heating hot water temperature would be set in accordance with the ambient air temperature.

12. Reduce Domestic Hot Water Temperature

The domestic hot water temperature was measured to be approximately 150° F. For hand washing and similar functions, this represents both a waste of energy and a potential safety hazard. The hot temperature increases tank and line losses. It is recommended that the temperature be reduced to approximately 100° F, although it will result in increased water usage. Before implementing this change, the adequacy of the hot water supply should be considered.

13. Maintenance of Air Handling Unit #1

The filters were found to be dirty, the controls were generally inoperative, and the fan belt guard was missing. Dirty filters reduce air flow and increase the load on the fan motor. Inoperative controls do not permit proper heating and cooling, and do not allow proper use of outside air during mild seasons. This can also cause other problems. The missing belt guard is a safety hazard.

14. Maintenance of Air Handling Unit # 2

The filters were found to be dirty and the outside air damper controller was inoperative. Filter replacement should be undertaken and the damper controller repaired or replaced.

15. Maintenance of Air Handling Unit # 3

The unit has a defective valve releasing steam. The valve should be repaired or replaced.

16. Hot and Cold Deck Reset on Multi-zone Systems

Air Handling Unit # 3 is a multi-zone unit. Based on the mechanical system drawings and the general condition of the controls, it appears that there is no hot and cold deck, reset on the unit. By optimizing the temperature of the hot or cold deck, the minimum amount of air mixing is required to maintain the temperature in a zone. Thus, by reducing the hot deck temperature during mild periods of the winter season, less by-pass air is required to cool the zone supply air.

17. Full Load Operation of Parallel Chillers

The building has two new chillers, each containing three 30 ton compressors. Currently, if more than one compressor is required, both chillers are operated. For example, if 60 tons of load is required, one compressor from each chiller is operated. The use of one chiller with two

compressors operating is more efficient than operating two chillers with one compressor each. By resetting the load controller on the chillers, the efficiency of the chilled water system can be increased.

18. Lighting ECOs

During a spot check in this building, illumination levels in excess of Army guidelines were found in hallways (100 footcandles) and in work areas (100-150 footcandles). The following items appear to have potential for energy savings in this area.

Delamping: Most fluorescent fixtures have four lamps. Where lighting levels permit, consideration should be given to removing two of the four lamps and disconnecting one ballast in such fluorescent fixtures.

Photo-electric Dimming: Rooms that have large amounts of sunlight are good prospects for photo-electric dimming. Economic feasibility of installing photo-electric dimmers in such rooms, which have high illumination levels, should be evaluated. Room 212 has one such application.

Static Dimming: For those rooms that do not have windows, but have high illumination levels, static dimmers should be considered.

Reflectors: In some areas, such as the lab rooms, the installation of reflectors would reduce energy usage, while providing adequate lighting levels..

Occupancy Sensors: Many of the rooms checked were vacant, but the lights were turned on. The feasibility of installing either ceiling-mounted or switch replacement occupancy sensors should be examined.

Replace Incandescent Lamps: Incandescent lamps, such as in room 236, should be replaced with screw-in fluorescent lamps.

10.3 Building 317

10.3.1 Building Description

General: Building 317 consists of a brick and hollow clay tile single story structure with a small basement utility room at the northeast corner. The total area of the building is approximately 16,500 square feet. Built prior to 1950, the building currently is used for laboratories and supporting office spaces.

HVAC: The building utilizes high pressure steam supplied from the central plant for heating and electricity supplied by Virginia Power is used for cooling. The main HVAC systems consist of two package rooftop units and two built-up air handling units and other smaller units throughout the building. The spaces supplied by the rooftop units have individual steam reheat coils and humidifiers. The built-up air handlers serve most of the remaining building area. One unit serves three separate reheat zones and the other unit serves five areas.

Domestic Hot Water: Building domestic hot water is provided by a small steam to hot water, shell and tube type convertor with a fractional hot water circulation pump. This unit is operating as an instantaneous water heater with no storage and serves a one inch hot water supply pipe.

10.3.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in paragraph 10.17, Summer Steam Use Evaluation.

10.3.3 Potential ECO's

1. Install Pipe Insulation

Uninsulated steam and condensate return lines allow heat to be ineffectively used. The heat loss warms the unoccupied mechanical room rather than providing heat to the preheat or reheat coils. It is estimated that 8' of 3/4" steam line and 5' of 1" and 5' of 1-1/2" condensate return lines in the mechanical room are not insulated. These bare pipes should be insulated.

2. Steam Trap Repair or Replacement

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since some steam is returned uncondensed, not all of the heat is utilized. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and reheat traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

3. Reduce Outside Air

According to the mechanical system drawings, a minimum of 8,400 cfm of outside air is provided to the laboratory. The quantity of outside air was based on the exhaust air from fume hoods and other exhaust fans. ASHRAE 62-1989 requirement for offices and the laboratory is 20 cfm per person. Typically, the fume hoods exhaust much larger quantities of air than the minimum required by ASHRAE. Since the estimated number of persons in the lab is 26, the outside air quantity required is 520 cfm. Based on available data from the drawings and the site visit; the exhaust fume hoods exhaust 2,300 cfm; about 90 cfm per person. In addition, the clean room has a separate exhaust system.

Therefore, it is recommended that the minimum outside air volume from the two air handling units be reduced to about 600-700 cfm. The quantity of air supplied to each room should ensure that a negative room pressure is maintained to minimize the spread of contaminants throughout the remainder of the building. Similarly, office and other common areas should be under positive pressure to minimize the likelihood of contaminants entering the rooms. To implement this ECO, new dampers and damper controls will be required. The systems will have to be carefully rebalanced to ensure proper pressurization in each room. The controls installed should complement the use of an economizer outside air control system and variable air volume or two speed fans. Other changes to the return air system may be required to balance the building ventilation system.

4. Reduce Supply Air

The quantity of conditioned air supplied to the occupied areas must be sufficient to heat or cool the space and to ensure the rooms do not feel stuffy. According to the mechanical system drawings, approximately 21,000 cfm is supplied to the building except for the clean room area. Thee is no indication that AHU # 1 and AHU # 2 were resheaved during the various renovations of the building. About one cfm per square foot should be adequate to provide proper cooling and heating if the ventilation system is balanced. Using variable air volume or two speed fans are other alternative methods of achieving the supply air reductions. The volume of air specified in the design drawings can be reduced by about 20 per cent, thereby reducing the fan energy needed to supply air to the building. Fan energy savings may be reduced by as much as 50 per cent.

5. Shut Off Equipment During Unoccupied Periods

Since the areas requiring strict temperature and humidity control have their own HVAC systems, it may be possible to shut down the central system for the building during unoccupied periods. The use of low and high limit thermostats will be required and should likely be adjusted to take into account the environmental requirements of the lab areas.

Time clocks or an EMC controller should shut down all applicable fans, pumps, and chillers when not needed. The savings will result from reduced heat transfer through building envelope, reduced ventilation load and due to reduction in equipment operation. It is important to include an override mechanism to ensure that personnel in the building during non-duty hours can get the necessary heating or cooling. This will require either a switch or an EMCS operator phone that is accessible to all personnel.

6. Warm Up and Cool Down Controls

In conjunction with shutting off the heating and cooling systems, it is recommended to use zero leakage dampers during building warm up in the winter and cool down in the summer. Since personnel are not occupying the building during an unoccupied period, outside air is not required. By installing low leakage outside air dampers and controls, only the recirculating air in the building needs to be tempered. This ECO should also be implemented in conjunction with an economizer control system to ensure cool air purging is used rather than using a chiller to bring the temperature down to acceptable level.

7. Economizer Control

The installation of an economizer control system would reduce the cooling requirements for the building. By using relatively cool outside air rather than having to cool warmer return air, the chiller may be shut off or the load on the chiller reduced. When the damper system is replaced, economizer controls should also be added to improve system efficiency.

8. Relocate Condensing Units Away from Outside Air Intake

The condensing units for the main air handling units are located very close to the outside air intake. During the cooling season, heat discharged from the condensing units is being drawn into the outside air intake. This heat adds to the cooling load thereby requiring more cooling

from the chillers and heat rejection from the condensing units. It is recommended that a low cost air deflector be used to deflect the air from the building.

9. Zone Optimization for Reheat Systems

Zone reheat systems typically use a fixed cold deck temperature and apply thermostatic controls to operate reheat coils to maintain comfort in each zone. If every zone is reheating, it is an indication that the cold deck is too cool. The site visit to the building was made on a cool day and the chillers were found to be operating. There was no indication that optimization controls were being used. By installing optimization controls, the cold deck is reset to a higher temperature to minimize the amount of cooling and heating required. Higher cold deck temperature require less cooling and higher supply air temperature require less reheating to maintain proper comfort.

10. Variable Air Volume Systems

Terminal reheat systems generally represent excellent opportunities for replacement with VAV systems. By varying the quantity of air supplied to the occupied space, proper cooling is provided. Based on the volume of the air supplied by the variable air volume boxes to cool the building, the volume of air supplied by the air handling unit is adjusted. As the load decreases, the quantity of air supplied decreases and the fan energy usage is reduced. There are two major considerations prior to installing this ECO. First, ensure that minimum outside air requirements are met. Second, ensure that adequate provisions for heating are incorporated into the design.

11. Reset Space Temperatures and Humidity

The building does not require strict temperature and humidity control with the exception of the clean room areas. Space temperature can be controlled over a wider range by the use of dead band thermostats. By allowing the space conditions to vary over a larger comfort range, the energy requirements can be reduced. Consequently, this reduces both chiller and reheat loads.

12. Two Speed Motors

The current ventilation system was designed to provide adequate outside air for a lab with numerous fume hoods. Because of the change in the function of the building, the supply and outside air quantities are in excess of normal office requirements. In addition, when the existing fume hoods are turned off (as they were found during the site visit), the need for the large amount of fume hood makeup air is eliminated. It is recommended that the replacement of existing motors with two speed motors as an alternative should be investigated. This ECO may be considered in lieu of conversion of the system to VAV as noted above. When fume hood exhaust reaches a specified level, the higher speed would be used. Under most conditions, the lower speed would be more than adequate. The reduced fan speed saves fan motor energy and the conditioning of outside air.

13. Install High Efficiency Motors

It is recommended that the existing motors be replaced with high efficiency motors. The evaluation of the replacement should be based on the annual hours of operation and the size of the motor. For the motors located in building 317, if the existing system operation remains unchanged (i.e., no night shut down), it is likely that a life cycle cost analysis will direct the immediate replacement of the motors. As an alternative, it is recommended that new motors be replaced with high efficiency motors at failure or during air handling system upgrade.

14. Raise Evaporator (Chilled Water) Temperature

Maintenance staff for infra-red lab buildings indicated that chilled water temperature is set at a constant temperature. Since line losses are greater for lower chilled water temperature as well as chillers run less efficiently at lower chilled water temperature, a chilled water temperature reset controller would improve energy efficiency. Chilled water temperature should be reset based on ambient conditions and building load.

15. Replace HVAC Controls

The controls on the air handling did not seem to be functioning properly during the site visit. For example, the outside air dampers were entirely closed even though the system was operating and the outside temperature was cool enough to warrant the use of outside air cooling. Also, pneumatic lines were found to be cut and therefore not functioning. In conjunction with other ECO's to be implemented, a complete replacement of the control system for the built-up air handling units (i.e.; dampers, heating and cooling valves, filter monitoring, etc.), is recommended.

16. Lighting ECOs

During a spot check in this building, illumination levels in excess of Army guidelines were found in hallways (100 footcandles) and in work areas (150-200 footcandles). The following items appear to have potential for energy savings in this area.

Delamping: Most fluorescent fixtures have four lamps. Where lighting levels permit, consideration should be given to removing two of the four lamps and disconnecting one ballast in such fluorescent fixtures.

Photo-electric Dimming: Rooms that have large amounts of sunlight are good prospects for photo-electric dimming. Economic feasibility of installing photo-electric dimmers in such rooms, which have high illumination levels, should be evaluated. Rooms 19, 21A, and 28 are some examples.

Static Dimming: For those rooms that do not have windows, but have high illumination levels, static dimmers should be considered.

Reflectors: In some areas, such as the lab rooms, the installation of reflectors would reduce energy usage, while providing adequate lighting levels.

Occupancy Sensors: Many of the rooms checked were vacant, but the lights were turned on. The feasibility of either ceiling-mounted or switch replacement occupancy sensors should be examined.

10.4 Building 327

10.4.1 Building Description

General: Building 327 is a 20 foot high, brick, hollow clay tile and steel structure with a first floor, center mezzanine floor and partial basement. The facility has a gross area of approximately 28,000 square feet. This building was built prior to 1950 and is currently used as office space. In the basement, all rooms with the exception of utility areas are apparently used for storage. The building is generally in poor condition.

HVAC: Building 327 is provided high pressure steam from the heating plant in building 332, which is reduced to medium pressure to serve AHU-1, 2, 3 and low pressure steam for heating hot water convertor. In addition, low pressure steam serves AHU-4 on the roof and air handlers in areas A & B.

Chilled water is generated by a nominal 150 ton centrifugal chiller with heat rejection by a cooling tower.

Air handlers 2, 3 and 4 are constant volume, constant discharge temperature machines that supply individual room hot water reheat coils. The building's other air conditioning systems are not dependent on steam during the cooling season.

Domestic Hot Water: The building is provided domestic hot water via a small steam to water convertor located in a basement mechanical room. The hot water is circulated to the building.

10.4.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in paragraph 10.17, Summer Steam Use Evaluation.

10.4.3 Potential ECOs

1. Repair or Replace Steam Traps

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since the steam is returned uncondensed, not all of the heat is used. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and reheat traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

2. HVAC System Analysis

According to the maintenance staff, the current HVAC system is scheduled for replacement in the near future. It is recommended that a careful review of available energy conservation techniques be performed. This includes the calculation of supply and outside air requirements, temperature and relative humidity restrictions, potential for shutdown/setback of the air handling units, reset of hot or chilled water, economizer controls, zone optimization, VAV, etc. The analysis should include many of the same items listed elsewhere in this report.

3. Install High Efficiency Motors

It is recommended that the existing large motors be replaced with high efficiency motors. The evaluation for replacement should be based on the annual hours of operation and the size of the motor. For the motors located in building 327, if the existing system operation remains unchanged (i.e.; no night shut down), it is likely that a life cycle cost analysis will direct the immediate replacement of the motors. As an alternative, it is recommended that new motors should be replaced with high efficiency motors at failure or during air handling system upgrade.

4. Raise Evaporator (Chilled Water) Temperature

The maintenance staff indicated that chilled water is set at a constant temperature. Since line losses are greater for chilled water at lower temperature and chillers run less efficiently at lower chilled water temperature, a chilled water temperature reset control would improve energy efficiency. Chilled water temperature should be reset based on ambient conditions or building load.

5. Leaks in the Steam Pit

Steam and hot water leaks were noticed in the steam pit outside the building. These must be repaired for safety and energy conservation.

6. Reduce Domestic Hot Water Temperature

The domestic hot water temperature was measured to be approximately 160° F. For hand washing and similar functions, this represents both a waste of energy and a potential safety hazard. The high temperature increases tank and line losses. This temperature can be reduced to approximately 100° F. Reducing the temperature will result in increased water usage. Before implementing this change, the adequacy of the hot water supply should be evaluated.

7. Lighting ECOs

This building was vacant and locked, while under extensive renovation at the time of the preliminary lighting survey. However, consideration should be given to improve the lighting system during the renovation.

10.5 Building 331

10.5.1 Building Description

General: Building 331 is a steel and masonry structure with brick and masonry exterior walls. Roof construction is built-up type over 2" insulation on steel deck supported by bar joists on steel beams. The building is 19'-0" high with the center section at 31'-0" for overhead crane operation. The basic building had a major addition in 1946 and numerous renovations over the years. The building has many large single pane windows and roll-up doors. Building 331 is currently housing a heating and air conditioning laboratory, office areas, paint spray facility, precision machine shop and materials handling areas, among others. The gross area of building 331 is approximately 64,100 square feet.

HVAC: Building 331 receives high pressure steam from the central heating plant, building 332, which is reduced to serve a steam to hot water convertor for the heating and A/C lab. The majority of the building is heated by steam unit heaters and the office areas have steam fin-tube radiation with summer cooling via small DX type split systems. Steam is required in summer for HVAC lab. and domestic hot water generation.

Domestic Hot Water: Building domestic hot water is provided by a small shell and tube, steam to hot water convertor, with a small in-line circulator and no storage tank. This equipment is located in a small basement mechanical space midway along the building's north wall.

10.5.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in paragraph 10.17, Summer Steam Use Evaluation.

10.5.3 Potential ECOs, Maintenance and Repair

1. Install Pipe Insulation

Uninsulated steam and condensate return lines throughout the building allow heat to be ineffectively used. The heat from the bare pipes warms the unoccupied mechanical rooms and other areas rather than providing heat to coils or heating equipment. Approximately 50' of 2" steam line and 125' of 1" condensate return lines in the mechanical room were not insulated. Damaged and missing areas of pipe insulation should be replaced.

Steam was blowing out of the building from the steam pit flash tank. If the condensate return lines are insulated, the steam "overflow" will increase. The increase will be caused by the reduced condensation of steam passed by bad traps.

2. Repair or Replace Steam Traps

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since some uncondensed steam is returned, not all of the heat is utilized. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

Based on the steam pouring out of the flash tank, it is likely that many or most of the traps are defective. When the condensate return lines are insulated, the reduced condensation will exacerbate the problem.

In the shop area, the steam and condensate return lines were insulated with asbestos. The asbestos was being removed and replaced with fiberglass insulation. All lines should be insulated at the conclusion of the contract.

3. Reduce Outside Air

ASHRAE 62-1989 requires offices and labs to provide 20 cfm per person. The two main office areas had small air handlers that may supply more outside air than the minimum requirement. The drawings of the existing air handling systems were not available. Since air volume measurements were not performed, the quality of outside or supply air could not be estimated. However, based on the design and operation of other office areas reviewed during this study, EAC believes that outside air reduction analysis should be performed.

Assuming this ECO is applicable to either of the air handling units, new dampers and damper controls will be required. The systems will have to be carefully rebalanced to ensure proper pressurization in each room. The controls installed should complement the use of an economizer air control system. Other changes to the return air system may be required to balance the building ventilation system.

4. Reduce Supply Air

The quantity of conditioned air supplied to the occupied areas must be sufficient to heat or cool the space and to ensure the rooms do not feel stuffy. As described above, the data was not available to determine if supply air volumes exceeded that required for the office areas. If the study for outside air is performed as recommended above, the data provided can be used to assess the potential to reduce the supply air volume. About one cfm per square foot should be adequate to provide proper cooling and heating if the ventilation system is balanced.

5. Shut Off Equipment During Unoccupied Periods

Since the areas requiring strict temperature and humidity control have their own HVAC systems, it may be possible to shut down the office systems during unoccupied periods. The use of low limit thermostats will be required to avoid pipe freezing and the inability of the system to bring the offices back to normal occupied period room temperature.

Time clocks or an EMCS controller should shut down all applicable fans, pumps, and chillers when not needed. The savings from this ECO will result from reduced heat transfer through building envelope, reduced ventilation load and a reduction of equipment operation hours.

It is extremely important to include an override mechanism to ensure that personnel in the building during non-duty hours can get the necessary heating or cooling. This will require either a switch or an EMS operator phone number that is accessible to all personnel.

6. Install Automatic Setback Thermostats on Unit Heaters

The existing unit heaters have standard thermostats and manual on/off switches. To be certain that the unit heaters are optimally used, install the setback thermostats "behind" the manual controls. Thus, if the control switch is shut off, the unit heater will not operate. If the switch is left on, the space temperature is controlled on a day/night setback schedule. The thermostats must be wired to operate when the manual control is turned off and must have battery backup to ensure proper operation after power failure. An override mechanism should be provided to ensure that personnel in the building can get the necessary heating during non-duty periods.

7. Warm Up and Cool Down Controls

In conjunction with shutting off the heating and cooling systems, it is recommended to use zero leakage damper during building warm up in the winter and cool down in the summer. When the personnel are not occupying the building, outside air is not required. Thus, while the HVAC system is bringing the building back to normal operating conditions, the need to heat or cool outside air in unnecessary. By installing low leakage outside air dampers and controls, only the recirculating air in the building needs to be tempered. This ECO should also be implemented in conjunction with an economizer control system to ensure cool air purging is used rather than using a chiller to bring the temperature down to an acceptable level.

8. Economizer Control

The installation of an economizer control system would reduce the cooling requirements of the building. By using relatively cool outside air rather than having to cool warmer return air, the chiller may be shut off or the load reduced. When the damper system is replaced, economizer controls should also be added to improve the system efficiency.

9. Install High Efficiency Motors

It is recommended that the existing motors be replaced with high efficiency motors. The evaluation of the replacement should be based on the annual hours of operation and the size of the motor. For the motors located in building 331, if the existing system operation remains unchanged (i.e., no night shut down), it is likely that a life cycle cost analysis will direct the immediate replacement of the motors. As an alternative, it is recommended that new motors be replaced with high efficiency motors at failure or during an air handling system upgrade.

10. Reduce Domestic Hot Water Temperature

The domestic hot water temperature was measured to be approximately 160° F. For hand washing and similar functions, this represents both a waste of energy and a potential safety hazard. Higher water temperature increases tank and line losses. The temperature can be reduced to approximately 100° F. Reducing the water temperature may increase water usage. Before implementing this ECO the adequacy of the hot water supply should be evaluated.

10. Install Local Exhaust System in Welding Area

The shop welding area currently uses a large exhaust fan to remove welding fumes. Although large quantities of air are exhausted, clouds of fumes can still be seen throughout the area. It is recommended that a smaller, more effective exhaust system be installed. The new system would provide fume exhaust at the site of the welding. This would not only decrease the fumes

in the area, but would decrease the air exhausted from the building. During the heating season, each cubic foot of air exhaust translates into a cubic foot of outside air that requires heating to a satisfactory indoor temperature.

12. Block and Insulate Windows

A large proportion of the exterior wall area has single pane windows. In the high bay areas, heat rises to the ceiling to be lost through the low U-value, poorly sealed windows. EAC suggests that an analysis be performed to determine if a portion of these windows be blocked over with an insulated panel.

13. Caulking

Caulking around the windows should be evaluated.

14. Heat Destratifying Fans

Consider heat destratifying fans for high bay areas to circulate hot air towards the floor.

15. Lighting ECOs

The measured lighting level in the work areas averaged about 150 fc which is excessive by Army guidelines. The following lighting ECOs, which may have potential savings, were identified.

New lighting system: An evaluation should be made for a new lighting system.

Delamping: Delamping will provide energy savings. However, it would be very noticeable and may be undesirable.

Photo-electric Dimming: Rooms that have large amounts of sunlight are good prospects for photo-electric dimming. Economic feasibility of installing photo-electric dimmers in such rooms, which have high illumination levels, should be evaluated.

10.6 Building 334

10.6.1 Building Description

General: Building 334 is a steel structure with 12" thick solid masonry exterior walls and built-up roofing over a steel deck supported by steel joists. The building was originally built as a railway shop and is currently used for temperature testing, storage and offices for SPSA. The office area starts in the north corner and runs down the northwest wall to include four 20 foot bays of both first floor and mezzanine. There is a small basement, mechanical equipment room and transformer vault in the building's north corner. The building's area is approximately 16,500 sq. ft.

HVAC: The building is served with high pressure steam from the central plant building 332. The pressure is reduced in the basement mechanical room to serve a heating hot water converter and a low pressure steam distribution system to unit heaters. The office area is air conditioned by dual temperature, 2-pipe fan coil units served hot water from the above mentioned convertor and glycol from a liquid chiller on the northeast exterior of the building. Six window air conditioning units are also utilized. In addition, a two ton DX system was being installed at the time of the site visit. The fan coil system has a summer/winter switch and does not use steam for summer reheat.

Domestic Hot Water: Domestic hot water is produced by a U-tube type steam to hot water convertor located in the basement mechanical room. The convertor functions as an instantaneous heater with no recirculating pump. This convertor is the only item requiring summer use of steam.

10.6.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in paragraph 10.17, Summer Steam Use Evaluation.

10.6.3 Potential ECOs

1. Install Pipe Insulation

Uninsulated steam and condensate return lines allow heat to be ineffectively used. The heat from the bare pipes warms ceiling in the high bay area rather than providing heat to the unit heaters. It was observed that at least 33' of 3/4" steam line and 2' of 3/4" and 20' of 1-1/2" condensate return lines throughout the high bay shop were not insulated. These pipes should be insulated.

2. Repair or Replace Steam Traps

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since some steam is returned uncondensed, not all of the heat is utilized. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

3. Install Automatic Setback Thermostats on Unit Heaters

The existing unit heaters have standard thermostats and manual on/off switches. Although the building was not surveyed during cold weather, a couple of the unit heaters were operating and others were manually shut off. To be certain that the unit heaters are optimally used,

thermostats should be installed "behind" the manual controls. Thus, if the control switch is shut off, the unit heater will not operate. If the switch is left on, the space temperature is controlled on a day/night setback schedule.

An override mechanism should be provided to ensure that personnel in the building can get the necessary heating during non-duty period.

4. Block and Insulate Windows

There are over 3,100 square feet of single pane windows in the high bay area. Most of the window area is near the ceiling of the building. An analysis should be performed to determine if a portion of these windows can be blocked over with insulated panels.

Note: EAC was not permitted in the office section of the building.

10.7 Building 357

10.7.1 Building Description

General: Building 357 is a steel structure with brick and concrete masonry unit exterior walls and aluminum casement poly-glass windows. The basic building stands 35 feet high with a small penthouse space 12 feet above main roof. Roof construction is built-up roofing over rigid insulation with vapor barrier, 2" poured deck, sub-purlin and form board. The facility consists of two full height levels with a 4'-6" clear interstitial utility space above each separated from the level served by a removable panel floor system. Building 357 is currently used as laboratory and office space for approximately 100 people.

HVAC: The building is provided high pressure steam from the central heating plant, in building 332, which is reduced in the mechanical room to low pressure to serve the heating hot water convertors and the domestic hot water generator. In addition, a low pressure steam main is run around the interstitial utility space to serve steam unit heaters and a few reheat coils for the utility spaces. Two carrier centrifugal water chillers furnish chilled water to the air conditioning system with heat rejected by open type cooling towers. A large built-up air handling unit located in the mechanical room provides conditioned air for the entire building, which is reheated by duct coils for individual spaces.

Domestic Hot Water: Domestic hot water is produced by a low pressure steam supplied hot water generator in the mechanical equipment room. The steam control valve has a capacity of 228 lbs/hr of low pressure steam.

10.7.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in paragraph 10.17, Summer Steam Use Evaluation.

10.7.3 Potential ECOs

1. Repair or Replace Steam Traps

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since some steam returns uncondensed, not all of the heat is used. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and reheat traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

2. Install Valve Insulation

Uninsulated steam and condensate return valves allow heat to be ineffectively used. the heat from uninsulated surfaces warms the unoccupied mechanical room rather than providing heat to the preheat or reheat coils. At least eight (8) valves in the mechanical room were not insulated. Although there will be only minimal energy savings, these valves should be insulated.

3. Insulate Hot Water Tank

The hot water tank for the reheat system was not insulated. As with the steam and condensate return lines and valves, hot water tanks should be insulated.

4. Shut Off Equipment During Unoccupied Periods

Strong consideration should be given to shutting down the central air handling unit during unoccupied periods. During the site visit, it was found that none of the fume hoods were operating on the first and second floors. However, since the third floor was not accessible, EAC was unable to determine the need for the central AHU to operate during unoccupied periods.

If separate systems exist to control the lab operations on the third floor, then system shutdown will not likely have an impact on lab operations.

5. Warm Up and Cool Down Controls

In conjunction with shutting off the heating and cooling systems, EAC recommends the use of zero leakage dampers during building warm up in the winter and cool down in the summer. Since personnel are not occupying the building, during off hours fresh air is not required. Thus, while the HVAC system is bringing the building back to normal operating conditions, the need to heat or cool outside air is unnecessary. By installing low leakage outside air dampers and controls, only the return air in the building needs to be tempered. This ECO should be coordinated with the economizer system to ensure cool air purging is used rather than using a chiller to bring the temperature down to operating conditions.

6. Reduce Outside Air

According the mechanical system drawings, a minimum of 24 per cent outside air is provided to the lab. Based on the full load volume of 107,610 cfm, fresh air entering the building would be nearly 27,000 cfm. The quantity of outside air was based on the exhaust air from fume hoods and other exhaust fans. The ASHRAE 62-1989 requirement for offices and labs is 20 cfm per person. Typically, lab fume hoods exhaust much larger quantities of air than the minimum required by ASHRAE.

Since the estimated number of persons in the lab is 100, the minimum total outside air quantity is 2,000 cfm. Based on available data from the drawings and site inspection, all exhaust fans for fume hoods and other requirements exhaust about 37,500 cfm; about 375 cfm per person. However, all of the fume hood exhaust fans were not operating during the site visit. Thus, it is very important that the variable inlet vane control system be carefully monitored to ensure excess outside air is not being heated/cooled.

Therefore, EAC recommends that a minimum outside air volume from the main AHU be reduced to about 2,000 cfm with additional makeup air being provided to maintain a balanced system when fume hoods are operating. The quantity of air supplied to each room with a fume hood should ensure that a negative room pressure is maintained to minimize the spread of contaminants throughout the remainder of the building. Similarly, offices and other common areas should be under positive pressure to minimize the likelihood of contaminants entering the rooms.

To implement this ECO, new dampers and damper controls may be required. The system will have to be carefully assessed and rebalanced to ensure proper pressurization in each room.

7. Reduce Supply Air

The quantity of conditioned air supplied to the occupied areas must be sufficient to heat or cool the space and to ensure the rooms do not feel stuffy. According to the mechanical system drawings, approximately 107,600 cfm is supplied to the building. Typically, about one cfm per square foot should be adequate to provide proper cooling and heating if the ventilation system is balanced. At two (2) cfm per square foot under full load, the main AHU should be able to maintain proper space conditions. EAC recommends that the inlet vane operation be carefully monitored to ensure that no excess air is heated/cooled.

8. Zone Optimization for Reheat Systems

Zone reheat systems typically use a fixed cold deck temperature and apply thermostatic controls to operate reheat cold to maintain comfort in each zone. If every zone is reheating, the cold deck is too cool and the load on the chiller can be reduced. The site visit was made on a cool day and the chillers were found to be operating. There was no indication that optimization controls were being used.

By installing optimization controls, the cold deck is reset to a higher temperature to minimize the amount of cooling and heating required. Higher cold deck temperature requires less cooling and higher supply air temperature requires less reheating to maintain proper comfort.

9. Reset Space Temperatures and Humidity

The entire building does not require strict temperature and humidity control. Therefore, space temperatures can be controlled over a wider range by the use of dead band thermostats. By allowing the space conditions to vary over a larger comfort range, the energy requirements are reduced. Consequently, this reduces both chiller and reheat loads.

10. Install High Efficiency Motors

EAC recommends that the existing motors be replaced with high efficiency motors. The timing of the replacement should be based on the annual hours of operation and the size of the motor. For the motor sizes located in building 357, if the existing system operation remains unchanged (i.e.; no night shut down), it is likely that a life cycle cost analysis will direct the immediate replacement of the motors. Once the hours of operation are reduced or the fan resheaved, the energy cost savings are decreased. Under these conditions, EAC recommends that new motors be replaced with high efficiency motors at failure or during AHU system upgrade.

11. Raise Evaporator (Chilled Water) Temperature

Maintenance staff for infra-rad lab buildings indicated that chilled water temperature set at a constant temperature. As the cooling load is reduced from design conditions, the chilled water is not reset to compensate for reduced cooling requirements. Since line losses are greater for lower chilled water temperatures and chillers run less efficiently at lower chilled water temperatures, a chilled water temperature reset controller would improve energy efficiency. Chilled water temperatures should be reset based on ambient conditions and/or load (similar to heating outside air reset controls).

12. Lighting ECOs

During a spot check in this building, illumination levels in excess of Army guidelines were found in hallways (70-100 footcandles) and in work areas (100-150 footcandles). The following items appear to have potential for energy savings in this area.

Delamping: Most fluorescent fixtures have four lamps. Where lighting levels permit, consideration should be given to removing two of the four lamps and disconnecting one ballast in such fluorescent fixtures.

Photo-electric Dimming: Rooms that have large amounts of sunlight are good prospects for photo-electric dimming. Economic feasibility of installing photo-electric dimmers in such rooms, which have high illumination levels, should be evaluated. Rooms 211, 229, 230 are some examples.

Static Dimming: For those rooms that do not have windows, but have high illumination levels, static dimmers should be considered.

Reflectors: In some areas, such as the lab rooms, the installation of reflectors would reduce energy usage, while providing adequate lighting levels.

Occupancy Sensors: Many of the rooms checked were vacant, but the lights were turned on. The feasibility of installing either ceiling-mounted or switch replacement occupancy sensors should be examined.

10.8 Building 362

10.8.1 Building Description

General: The original building was built in 1962 with an addition added to the north end in 1970. The building is a steel and concrete structure with masonry exterior and is about thirteen feet high. The original building roof is built-up type over 2" rigid insulation on a 2" light weight concrete slab. The addition has a 5 ply built-up roof over 2" rigid insulation with a 1-1/2" steel deck. The roofs are supported by steel joists. There are basements under the north and south sections which are constructed of poured concrete. The center section of the building has a 8" slab on grade floor. The gross area is 17,584 sq. ft. and the building is currently used as a laboratory and has supporting office areas.

HVAC: The old section of building 362 had its HVAC system renovated in 1987 and the original air handlers and associated steam coils, finned tube radiation and distribution piping and ductwork were removed. The current HVAC system consists of a new steam PRV station serving a steam to hot water convertor and an air-cooled reciprocating liquid chiller. These provide dual temperature water to five packaged air handling units and 22 perimeter fan coil units. Air handling units 2 and 3 have had steam reheat coils added for summer humidity control in the laboratory area they serve. The 1970 addition is served by a small multi-zone air handler.

Domestic Hot Water: Building domestic hot water is provided by a 100 gal hot water storage generator with a steam U-tube heating element providing 180 GPH recovery at 156 lbs/hr steam at 5 PSIG. This unit was installed in 1987.

10.8.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in paragraph 10.17, Summer Steam Use Evaluation.

10.8.3 Potential ECOs

1. Repair or Replace Steam Traps

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since some of the steam is returned uncondensed, not all of the heat is used. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and reheat traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

2. Repair Leaking Valve

Air handling Unit No. 1 located in the basement next to the stairwell has a leaking steam valve; it should be repaired.

3. Shut Off Equipment During Unoccupied Periods

Air Handling Units 1 through 4 may be shut down during unoccupied periods. These systems have the existing capability to be setback during unoccupied periods. However, each setback control has been overridden for various reasons. Each area served by these air handling units should be re-evaluated to determine if the system should be shut down during unoccupied hours.

Re-evaluation of Air Handling Units 2, 3 and 4 is very important because each currently operate at 100 per cent outside air. Although the setback control scheme calls for the outside air dampers to be closed and return air dampers fully open, the "normal" operation mode permits 10 per cent outside air into the building on a continuous basis. The addition of low and high limit thermostats to control Air Handling Unit No 1. should be considered to prevent freezing, overheating, or high humidity in the office space.

The use of the existing timeclocks or addition of an EMC controller should shut down all applicable fans, pumps, and chillers.

An override mechanism should also be included to ensure that personnel in the building during non-duty hours can get the necessary heating or cooling. This will require either a switch or an EMC operator phone number that is accessible to all personnel.

4. Warm Up and Cool Down Controls

In conjunction with the shutting off of the heating and cooling systems, the use of zero leakage dampers during building warm up in the winter and cool down in the summer is recommended. When the office personnel are not occupying the building, fresh air is not required. Thus, while the HVAC system is bringing the building back to normal operating conditions, the need to heat or cool outside air in unnecessary. By installing low leakage outside air dampers and controls, only the return air in the building needs to be tempered.

5. Zone Optimization for Reheat Systems

Zone reheat systems typically use a fixed cold deck temperature and apply thermostatic controls to operate reheat coils to maintain comfort in each zone. If every zone is reheating, the cold deck is too cool. During such period, the load on the chiller can be reduced. The building was surveyed on a cool day and the chillers were found to be operating. There was no indication that optimization controls were being used. By installing optimization controls, the cold deck

is reset to a higher temperature to minimize the amount of cooling and heating required. Higher cold deck temperature requires less cooling and higher supply air temperature requires less reheating to maintain proper comfort.

6. Hot and Cold Deck Reset on Multi-Zone Systems

Air Handling Unit No. 1 is a multi-zone unit. Based on the mechanical system drawings and the general condition of the controls, it can be assumed that there is no hot and cold deck reset on the unit. By optimizing the temperature of the hot and cold deck, the minimum amount of air mixing is required to maintain zone temperatures. Thus, by reducing the hot deck temperature during mild periods of the winter season, less by-pass air is required to cool the zone supply air.

7. Variable Air Volume Systems

Terminal reheat systems generally represent excellent opportunities for replacement with VAV systems. By varying the quantity of air supplied to the occupied space, proper cooling is provided. Based on the volume of the air supplied by the variable volume boxes to cool the building, the volume of air supplied by the air handling unit fan is adjusted. As the load decreases, the quantity of air supplied decreases and the fan energy usage is reduced.

The implementation of this option should provide large savings for the lab areas. Air Handling Units 2 - 5 are all constant volume 100 per cent outside air systems. Fume hood requirements are the primary reason for the large outside air quantities ($>$ 12,000 cfm) being supplied to the space. Since all of the fume hoods inspected during the site visit had been shut off, there no longer was a requirement for 12,000 cfm of outside air. However, there will be periods when the fume hoods will be operating and the outside air will be necessary. Therefore, a variable air volume system would be set up to sense the lab static pressure and fume hood operating signals and adjust the quantity of supply air to the rooms accordingly.

8. Install High Efficiency Motors

It is recommended that large existing motors be replaced with high efficiency motors. For the motors located in building 362, if the existing system operation remains unchanged (i.e.; no night shut down), it is likely that a life cycle cost analysis will direct the immediate replacement of the motors. If the hours of operation are reduced or the fans are resheaved, the energy cost savings will be decreased. Under these conditions, new motors should be replaced with high efficiency motors at failure or during air handling system upgrade.

9. Raise Evaporator (Chilled Water) Temperature

Maintenance staff indicated that chilled water temperature is set at a constant temperature. Since line losses are greater for lower chilled water temperature and chillers run less efficiently at lower chilled water temperature, a chilled water temperature reset control would improve energy efficiency. Chilled water temperatures should be reset based on ambient conditions or building load.

10. Reduce Domestic Hot Water Temperature

The domestic hot water temperature was measured to be approximately 180° F. For hand washing and similar functions, this represents both a waste of energy and a potential safety hazard. Higher water temperature increases tank and line losses. The temperature can be reduced to approximately 100° F. Reducing the water temperature may increase its usage. Before implementing this ECO, the adequacy of hot water supply should be evaluated.

16. Caulking

Caulking of the around the windows should be performed.

17. Lighting ECOs

During a spot check in this building, illumination levels in excess of Army guidelines were found in hallways (70-100 footcandles) and in work areas (120-175 footcandles). The following items appear to have a potential for energy savings in this area.

Delamping: Most fluorescent fixtures have four lamps. Where lighting levels permit, consideration should be given to removing two of the four lamps and disconnecting one ballast in such fluorescent fixtures.

Photo-electric Dimming: Rooms that have large amounts of sunlight are good prospects for photo-electric dimming. Economic feasibility of installing photo-electric dimmers in such rooms, which have high illumination levels, should be evaluated. Rooms 108C, and 115A are some examples.

Static Dimming: For those rooms that do not have windows, but have high illumination levels, static dimmers should be considered.

Reflectors: In some areas, such as the lab rooms, the installation of reflectors would reduce energy usage, while providing adequate lighting levels.

Occupancy Sensors: Many of the rooms checked were vacant, but the lights were turned on. The feasibility of installing either ceiling-mounted or switch replacement occupancy sensors should be examined.

Replace fixtures: Locations, such as the waiting areas around rooms 103, 104, 105, and 106, should be given consideration for new and more efficient fixtures.

10.9 Building 363

10.9.1 Building Description

General: Building 363 is a one story structure with equipment located in the basement and the penthouse. The building was built in 1952 and subsequently improved. Exterior walls are 12 inch concrete masonry below grade and 12 inch concrete masonry cavity type elsewhere. The building's structure consists of a steel and concrete frame with concrete pan first floor slab and built-up roof over rigid insulation on a concrete deck supported by steel joists. With a gross area of approximately 31,000 square feet, the building houses laboratories and offices for 30 to 40 employees.

HVAC: The building receives high pressure steam from the central plant in building 332 which is reduced to medium pressure to serve the building's process and domestic hot water loads and then to low pressure for the heating hot water convertor. Cooling medium is chilled water provided by packaged water chilling equipment located outside on the east side of the building. Two large rooftop units serve the entire facility with conditioned air which is reheated. Spaces are provided with individual room reheat coils and small heating and ventilating units provide make-up air to fume hoods. Each AHU system has a return air fan and the building has several small exhaust fans.

Domestic Hot Water: Building domestic hot water is being provided by a steam to hot water generator located in the mechanical room. The steam control valve is capable of supplying 165 lbs/hr. @ 30 psig.

10.9.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in paragraph 10.17, Summer Steam Use Evaluation.

10.9.3 Potential ECOs

1. Install Pipe and DHW Tank Insulation

Uninsulated steam and condensate return lines and hot water tanks allow heat to be ineffectively used. The heat from bare surfaces warms the unoccupied mechanical room rather than providing heat to the preheat or reheat coils or hot water. Missing insulation was noticed throughout the mechanical room (B107) during the site visit. However, various renovation projects were underway in nearby areas, the piping and tank may have been insulated under those projects.

Since insulating and hot water piping and tanks are fast payback items, the lines and tank should be rechecked for insulation. If they are still not insulated, missing insulation should be installed. Further, the uninsulated piping was located at body height. Thus, not only is heat being lost, but this condition also represents a safety hazard.

2. Repair or Replace Steam Traps

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since some uncondensed steam is returned, not all of the heat is utilized. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the steam traps in the mechanical room be tested semi-annually and reheat traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

3. Zone Optimization for Reheat Systems

Zone reheat systems typically use a fixed cold deck temperature and apply thermostatic controls to operate reheat coils to maintain comfort in each zone. If every zone is reheating, the cold deck temperature can be raised, thus reducing load on the chiller. According to the drawings, zone optimization is not being used. By installing optimization controls, the cold deck can be

reset to a higher temperature to minimize the amount of cooling and reheating required. Higher cold deck temperature requires less cooling and the air requires less reheating to maintain proper comfort.

4. Outside Air Reset

A hot water convertor is used for reheat coils and other heating equipment. Based on the mechanical drawings and the site visit, an outside air reset system has not been installed. The hot water convertor temperature is set for 160° F. to 180° F. regardless of the ambient conditions. During milder periods of the heating season, this may cause overheating and unnecessary line losses. It is recommended that an outside air reset controller be installed on the hot water convertor. The heating hot water temperature should be varied in accordance with the ambient air temperature.

5. Reduce Domestic Hot Water Temperature

The domestic hot water temperature was measured to be approximately 150° F. For hand washing and similar functions, this represents both a waste of energy and a potential safety hazard. This temperature can be reduced to approximately 100° F. Reducing the water temperature may increase its usage. Before implementing this ECO, the adequacy of hot water supply should be evaluated.

6. Weatherstrip Doors

The weatherstripping on the door to the building is no longer effective. To reduce energy losses and decrease uncomfortable drafts, it is recommended that the weatherstripping on all of the doors be replaced.

7. Lighting ECOs

During a spot check in this building, illumination levels in excess of Army guidelines were found in hallways (100 footcandles) and in work areas (50-150 footcandles). The following items appear to have a potential for energy savings in this area.

Delamping: Most fluorescent fixtures have four lamps. Where lighting levels permit, consideration should be given to removing two of the four lamps and disconnecting one ballast in such fluorescent fixtures.

Photo-electric Dimming: Rooms that have large amounts of sunlight are good prospects for photo-electric dimming. Economic feasibility of installing photo-electric dimmers in such rooms, which have high illumination levels, should be evaluated. Rooms 107, 112, 113, 118 and 121A are some examples.

Static Dimming: For those rooms that do not have windows, but have high illumination levels, static dimmers should be considered.

Reflectors: In some areas, such as the lab rooms, the installation of reflectors would reduce energy usage, while providing adequate lighting levels.

Occupancy Sensors: Many of the rooms checked were vacant, but the lights were turned on. The feasibility of installing either ceiling-mounted or switch replacement occupancy sensors should be examined.

10.10 Building 365

10.10.1 Building Description

General: Building 365 is a 39 x 75 foot masonry structure with steel open web joists supporting a roof of form board, 2" gypsum, 2" rigid insulation and built-up roofing. There is an 18 foot high roof area with a mezzanine and the remaining area has a 12 foot roof height. Exterior walls are 8" block with interior plaster finish. The facility has a gross square footage of 4880 and is currently being used as office space for 26 employees.

HVAC: Building 365 is provided high pressure steam service from the central heating plant in building 332, which is reduced to low pressure in the small mechanical room to serve a steam to hot water converter to produce heating hot water for this building. Cooling is provided by a 30 ton reciprocating liquid chiller package by Technical Systems, Inc., which is pad mounted on the east side of the facility. Air conditioning is through three packaged roof top air handling units. Use of summer steam is not necessary for this equipment.

Domestic Hot Water: Building 365 is provided domestic hot water by a vertical steam generated hot water storage heater located in the small mechanical room. The domestic hot water generator requires summer steam to operate.

10.10.2 ECOs Investigated

The steam usage during summer has been evaluated for this building based on the methodology described in paragraph 9.3. The results of this evaluation are given in paragraph 10.17, Summer Steam Use Evaluation.

10.10.3 Potential ECOs

1. Repair or Replace Steam Traps

Failed traps allow steam to pass into the condensate return lines rather than be used for heating. Since some of the steam is returned uncondensed, not all of the heat is utilized. However, the heat of vaporization is lost when the steam condenses in the condensate return system. It is recommended that the mechanical room steam traps be tested semi-annually and reheat traps outside the mechanical room be tested annually. Failed steam traps should be repaired or replaced as required.

2. Reduce Outside Air

ASHRAE 62-1989 requires offices to provide 20 cfm per person. The building has three air handling units to service the two floors. These air handling units may be supplying more than this requirement. The construction drawings are not available. Since air volume measurements were not performed, the quantity of outside or supply air being provided to the offices could not be determined. However, based on the design and operation of other office areas reviewed during this study, it is recommended that outside air reduction analysis be performed.

Assuming this ECO is applicable to all of the air handling units, new dampers and damper controls will be required. The systems will have to be carefully rebalanced to ensure proper pressurization in each room. The controls installed should complement the use of an economizer air control system. Other changes to the return air system may be required to balance the building ventilation system.

3. Reduce Supply Air

The quantity of conditioned air supplied to the occupied areas must be sufficient to heat or cool the space and to ensure satisfactory indoor air quality. As described above, the data was not

available to determine if supply air volume exceeded that required for the office areas. If the outside air study is performed as recommended above, the data generated can be used to asses the potential to reduce the supply air volume. About one cfm per square foot should be adequate to provide proper cooling and heating if the ventilation system is balanced.

4. Rebalance Supply Air System

The supply air system is not properly balanced in the building. During the site visit, two problems related to air imbalance were noted. First, overheating in some areas is causing the staff to open windows to temper the space conditions. The overheating increases the energy used to heat (and probably during the summer months, cool) the building. The imbalance causes excessive warm supply air into one area while starving others. Second, the staff complained of excessive noise in the offices, especially in the areas with too much air. Although measured to be within acceptable limits by the maintenance contractor, the noise levels caused staff to speak loudly in many areas of the building to be heard. The aggravation and possible lost time to the staff should also be ample reason to rebalance the system and correct any noise problem that remains after the rebalancing.

5. Shut Off Equipment During Unoccupied Periods

The three packaged rooftop air handling units should be shut down during unoccupied periods. The use of low limit thermostats set at 45° F. to 55° F. will be required. Due to the computer usage in the building, a high limit thermostat may also be installed for summer operation to avoid overheating or to avoid high humidity. The timeclocks or EMCS controller should shut down all applicable fans, pumps, and chillers.

An override mechanism should be included to ensure that the personnel in the building during non-duty hours can get the necessary heating or cooling. This will require either a switch or an EMCS operator phone number that is accessible to all personnel.

6. Warm Up and Cool Down Controls

In conjunction with the shutting off of the heating and cooling systems, the use of zero leakage dampers during building warm up in the winter and cool down in the summer is recommended. When the personnel are not occupying the building, outside air is not required. Thus, while the HVAC system is bringing the building back to normal operating conditions, the need to heat or cool outside air in unnecessary. By installing low leakage outside air dampers and controls, only the recirculating air in the building needs to be tempered. This ECO could also be implemented in conjunction with the economizer control system to ensure cool air purging is used rather than using the chiller to bring the temperature down to operating conditions.

7. Economizer Control

The installation of an economizer control system would reduce the cooling requirements in the building. By using relatively cool outside air rather than having to cool warmer return air, the chiller may by shut off or the load reduced. When the damper system is replaced, economizer controls should also be added to improve the system efficiency. Since equipment shop drawings and the mechanical system plans were not available, it cannot be stated with certainty whether this ECO has already been incorporated into the equipment.

8. Replace HVAC Controls

The controls on the rooftop air handling units did not appear to be functioning properly during the site visit. For example, the outside air dampers were entirely open even though the outside temperature was about 42° F. In conjunction with other ECO's to be implemented, it is recommended that the control system for each of the air handling units, consisting of dampers, heating and cooling valves, filter monitoring, etc., should be repaired.

9. Outside Air Reset

A hot water convertor is used to provide hot water to the air handling unit heating coils. Based on the site visit, an outside air reset system has not been installed. The hot water temperature during the site visit was 145° F., too high for the mild outside temperature. During milder periods of the heating season, this causes overheating and unnecessary line losses. It is recommended that an outside air reset controller be installed on the hot water convertor. The temperature of the water would be set in accordance with the ambient air temperature.

10. Correct Flash Tank Problem

Steam was noticed to be escaping from the flash tank. Although this is the function of the tank, the excessive steam is likely caused by poor traps or an undersized flash tank. The cause of this problem should be identified and corrected.

11. Lighting ECOs

During a spot check in this building, illumination levels in excess of Army guidelines were found in hallways (75 footcandles) and in work areas (100-150 footcandles). The following items appear to have a potential for energy savings in this area.

Delamping: Most fluorescent fixtures have four lamps. Where lighting levels permit, consideration should be given to removing two of the four lamps and disconnecting one ballast in such fluorescent fixtures.

Photo-electric Dimming: Rooms that have large amounts of sunlight are good prospects for photo-electric dimming. Economic feasibility of installing photo-electric dimmers in such rooms, which have high illumination levels, should be evaluated. Rooms 3,6 and are some examples.

Static Dimming: For those rooms that do not have windows, but have high illumination levels, static dimmers should be considered.

Reflectors: In some areas, such as the lab rooms, the installation of reflectors would reduce energy usage, while providing adequate lighting levels..

Occupancy Sensors: Many of the rooms checked were vacant, but the lights were turned on. The feasibility of installing either ceiling-mounted or switch replacement occupancy sensors should be examined.

10.11 Building 505A

10.11.1 Building Description

This is an electrical substation that serves the 0-99, 200, 400, and 500 areas. It is a 4.16 Kv substation. The substation has a total of eight circuits, with five meters monitoring the Kwh only. This substation is also tied to substations 1156 and 327A.

10.11.2 Peak-Shaving Generator

Two options were conceptualized for analysis for using a generator, namely

Option A: Peak Shaving - Use generator during on-peak hours to reduce electrical demand.

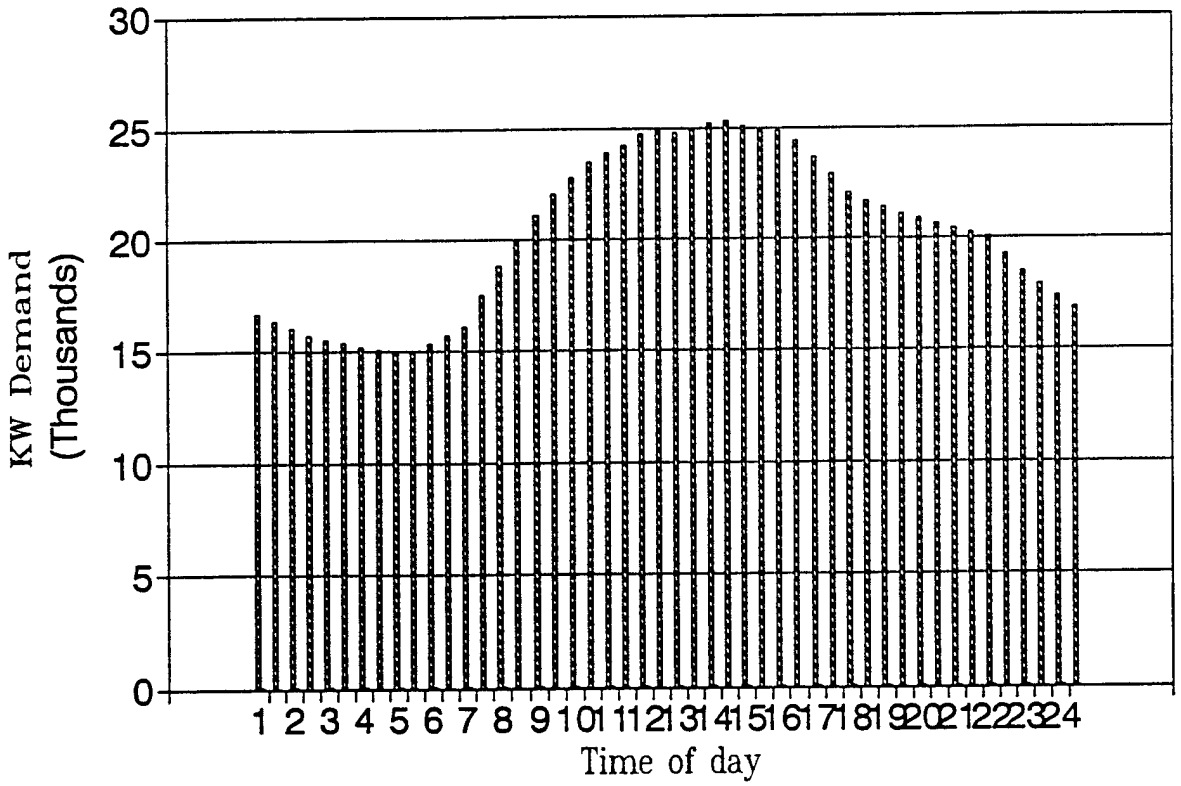
Option B: Standby Generator - Participate in Virginia Power Standby Generator Program under rate schedule MSSG.

There is sufficient room within the fenced area in the substation to locate a generator. Hence, the study assumes that the generator would be located in an enclosure in this location.

Option A - Peak Shaving

The feasibility of the installation of a generator in Substation 505 A consists of analyzing the electrical demand curve for the entire post. This is necessary since the entire post is master metered. Therefore, any impact must be considered with respect to the total demand for the entire post in mind. A demand curve for the post follows.

Electrical Peak Demand
Fort belvoir



An analysis of the demand curve for the peak day in July shows the following:

ESTIMATED ELECTRICAL BILLING DEMAND WHEN USING A GENERATOR

TIME OF DAY GENERATOR ON	KW DEMAND SAVED	GENERATOR HOURS/DAY	ESTIMATED TOTAL BILLING KW DEMAND
1100-1615	1076	5.3	24,230
1110-1540	884	4.8	24,422
1130-1540	614	4.2	24,692
1140-1535	500	3.9	24,806
1150-1500	422	3.2	24,884
1310-1445	346	1.6	24,960
1315-1430	270	1.3	25,036
1330-1420	154	0.8	25,152

The third column shows the number of hours that the generator will be required to run in order to achieve the kW reductions stated in column 2. The next step is to determine the optimum size generator. This analysis utilizes the metering data for circuits number 3, 5, 6, 7 and 8, which are the only circuits for which such data is available. The following table shows the estimated load for each circuit and the estimated coincidental demand with the overall peak demand for the Post.

EXPECTED COINCIDENTAL KW AVAILABLE AT SUBSTATION 505 A

CIR NO.	ESTIMATED AVERAGE PEAK LOAD (KW)	ESTIMATED AVAILABLE COINCIDENTAL KW (DIVERSIFIED)	GENERAL AREA SERVED
Cir. 3	336	269	0-90 Area
Cir. 5	431	345	200 Area
Cir. 6	818	655	400 Area
Cir. 7	573	458	0-90 Area
Cir. 8	395	316	500 Area

The following table shows the generator size required for each respective circuit and the time of day the generators would have to run in order to achieve the kW demand reductions shown above.

CIRCUIT NUMBER	GEN'TR SIZE (KW)	TIME OF DAY GENERATOR ON	GENERATOR HOURS/DAY	KWH GEN'D PER MONTH
3	600	1310-1430	1.4	9,018
5	750	1305-1450	1.8	15,016
6	1500	1120-1545	4.4	70,470
7	1000	1135-1530	3.9	40,841
8	750	1310-1445	1.6	11,743

The process of optimizing the size of the generator involves a comparison of total annual cost versus total annual savings for the different size generators. While the larger generators can save more kW demand, they cost more and must run for longer periods, thereby decreasing their life expectancy. In this analysis the kWh energy charges and kW demand charges that can be saved by running the different size generators, have been calculated. Accordingly, the total annual cost has been calculated using three main components. These three components are the cost of generating the required kWh, the maintenance cost and the capital cost. The cost of generation is calculated based on the running hours required using the fuel consumption for the different size generators. The maintenance cost is also calculated based on the generator running time.

The total cost is compared to the total savings for each generator so that the generator with the greatest net annual savings is selected. The cost and savings data is then used to perform ECIP analysis.

It must be noted that the calculated savings may not be achieved if, for any reason, peak load occurs during any period other than the period assumed for the study. One way to ensure that the calculated savings are achieved may be by the use of the EMCS equipment, or any other load monitoring equipment. This will ensure that the generators are turned on even if it is

outside the two hour window provided for in the calculations. Also, if the demand is monitored, it would not be necessary to run the generator every day during the summer months, but only on the days of high demand.

Diesel Generator:

At Substation 505 A, by using the method described above, a 750kW diesel generator starting at 1300 hours and running approximately 1.8 hours per day will provide the maximum amount of net annual savings. The diesel generator will be installed at the substation, in an enclosure. An automatic transfer switch will also be located at the substation in a weatherproof type cabinet.

The following assumptions have been made for this analysis:

1. The generator would have a closed transition automatic transfer switch to avoid any flickering effect on the load when the generator would come on the line.

2. Average generator fuel consumption is based on the manufacturer's data.

3. Calculations are based on running the generator 22 work days every month for the months of June through September, which are the designated summer months as per Virginia Power rate schedule MS.

4. The generator will run for 1.8 hours starting at 1300 hours every day during the summer months.

5. The electrical load reduction of 345kW from the electrical demand billing would be achieved every summer month. This would, in turn, affect the minimum demand billed during the winter months, currently 90% of the peak summer month demand.

Natural Gas Generator:

The analysis for the natural gas generator is similar to the analysis for the diesel generator, with the exception to the size of natural gas generator used. The size of the generator is based on the standard size available from the manufacturer. A 630 kW natural gas generator has been selected for the purpose of analysis. This generator, starting at 1310 hours and running 1.6 hours per day will provide the maximum amount of net savings. The natural gas generator will be installed at the substation, in an enclosure. A distribution gas line would be installed for a distance of approximately 250 feet from 23rd street. An automatic transfer switch will also be located at the substation in a weatherproof type of cabinet.

The following assumptions were made for this analysis:

1. The generator would have a closed transition automatic transfer switch to avoid any flickering effect on the load when the generator would come on the line.

2. Average generator fuel consumption data is based on manufacturer's data.

3. Calculations are based on running the generator 22 work days every month for the months of June through September, which are the designated summer months as per Virginia Power rate schedule MS.

4. The generator will run for 1.6 hours starting at 1310 hours every day during the summer months.

5. The electrical load reduction of 316kW from the electrical demand billing would be achieved every summer month. This would, in turn, affect the minimum demand billed during the winter months, currently 90% of the peak summer month demand.

As indicated for an oil generator, it must be noted that the calculated savings may not be achieved if, for any reason, peak load occurs during any other period. This may be achieved by the use of the EMCS equipment, or any other load monitoring equipment.

Option B: Standby Generator

Under this program, Virginia Power may request operation of the customer's standby generator only from December 1 through March 31 (winter) during the hours between 0600 and 1200, weekdays, or from June 1 through September 30 (summer) during the hours between 1400 and 2000, weekdays. Virginia Power will pay the metering costs and will install meters near the generator to measure the kW generated during the requested period. The payment of $6.00 per kW of average capacity generated, as contracted for, is paid for 6 summer months and for 6 winter months. The participating customer may request that hours of one generation request be excluded in determination of the average capacity generated in a particular billing month. This one time exclusion is an advantage over the peak shaving option since no penalty is incurred for an isolated instance when the generator may not meet the load.

Diesel and Natural Gas Generators:

As for peak shaving, the analysis for the standby diesel generator has been performed using a 750 kW diesel generator and a 630 kW natural gas generator. The circuits are the same as used for the peak shaving option.

Following is a summary of ECIP analysis for this ECO:

		Energy Saved, Mbtu/year				Payback
Option	Generator	Electric	Oil/Gas	Total	SIR	Period
A	Diesel	205	-791	-586	1.2	8.7
	Natural Gas	160	-711	-551	0.9	11.9
B	Diesel	101	-383	-281	0.4	25.0
	Natural Gas	101	-708	-607	0.3	35.4

10.12 Building 1359 (Control Tower)

10.12.1 Building Description

General: Building 1359 functions as the Aircraft Control Center for Davison U.S. Army airfield. The tower is a steel structure with exterior walls of CMU on the ground floor and sandwich metal panels on the floors above. The metal panels appear to be provided with approximately one inch of fiberglass insulation in-between. The building has seven levels and a gross area of approximately 2,870 sq. ft. The floors are concrete slab. The windows below level seven are single thickness metal casement type. The observation level is furnished with inward sloping thermopane double glazing. Roof is built-up type over rigid insulation on a metal deck. Seventh level has acoustical lay-in ceiling.

HVAC: The Control Tower is furnished low pressure steam from the adjacent building 1351, which is distributed to radiators, unit heaters and an air handling unit. Cooling is provided by a ten ton liquid chiller outside the north corner of the building. Chilled water is circulated to five fan coil units and an air handling unit.

10.12.2 Energy Model

A computer simulation on the E20-II, HAP 20 program was made to analyze the building systems and to determine energy savings. The following assumptions are applicable to this simulation:

- Infiltration values are based on ASHRAE 1989 Fundamentals Handbook (p.23.17). However, based on field observations and discussions with the tenants, it has been learned that they have tried to plug cracks and gaps in the building walls to reduce infiltration. As such, for baseline simulation, the infiltration values were increased by 100% for the control room floor and 50% in other areas.

- Where steam to radiator and unit heater flows unrestricted, overheating to 80° F. has been assumed in these areas.

- The equipment data is based on drawings and manufacturer's catalog.

- The building heating requirements are met by steam from the central boiler plant in Building 1351.

Based on these assumptions, the building systems data input obtained from drawings, field data and interviews, an energy systems simulation was performed. Next, the energy conservation opportunities (ECOs) were identified and those considered technically feasible were simulated.

In order to simulate all systems appropriately, some spaces were simulated for cooling and heating separately. The discrepancy in square footage and energy usage by lighting and miscellaneous energy consuming systems has been corrected by simulating an imaginary space for these loads only and adjusting the corresponding values for these systems.

10.12.3 ECOs Evaluated

The ECOs were prioritized based on a preliminary computer simulation and resimulated successively to generate savings synergistically. The following ECOs were evaluated for this building:

1. Wall Insulation

It is proposed to add 2" wall insulation (R-11) by installing an exterior wall insulation system. This will improve the U-value for the wall assembly from 0.4 to 0.074 Btu/hr-SF-°F. The building energy usage was re-simulated with the new U-value for the wall.

2. Roof/Ceiling Insulation

Six inches of batt insulation will be installed above the suspended ceiling to provide additional R-19 insulation. The U-value will improve from 0.22 to 0.0425 Btu/hr-SF-°F. The energy usage was re-simulated as for wall insulation and savings determined.

3. Replace Single Glazed Windows with Double Glazed Windows

The existing windows in this building are all single-glazed, except those in the control room level. These existing and proposed windows have the following characteristics:

	Existing	Proposed
U-Value	1.0	0.58
Glass Factor	1.0	0.9

Computer simulation with the new characteristics generated the new energy usage, which compared to base building simulation provided the energy savings values.

4. Weatherstripping

To determine the energy savings, the building systems were simulated by changing the infiltration values to the calculated values. It is assumed that weatherstripping will plug the cracks and gaps, as mentioned in assumptions for energy model in 10.12.2.

5. Night Setback

The building does not have any night setback controls. Under this ECO, time clock controls will be provided for the HVAC systems to save energy during the unoccupied period. A

computer simulation by E20-II, HAP 20 program generated energy usage with this ECO in place.

6. Radiator/Unit Heat Control Valves

As described in the 10.12.2, free flow of steam in the radiator and unit heater causes overheating. Control valves are proposed to cut-off steam when a preset temperature (68°F.) is reached. The energy usage simulation was performed with this parameter.

7. Reflectors

The fluorescent light fixtures on the third floor are open type fixtures. It is proposed to install reflectors to generate savings in lighting and cooling costs. However, heating costs will increase by a small margin. The ECO was also simulated to generate the energy usage pattern.

8. Occupancy Sensor

Lights in the conference room on the sixth floor stay on for a long period of time. An occupancy sensor will turn the lights off when not required. As for reflectors, energy savings in lighting and cooling will be offset by marginal increases in heating energy.

Originally all ECOs were evaluated independently of each other, and were ranked according to the highest to lowest SIR. Then the ECO with the highest SIR was simulated followed by the next ranked ECO. This calculation was performed with the first ECO in place. This process was carried out for all ECOs, and a new SIR was calculated which resulted in a new ranking. The calculations were repeated a number of times, until a true ranking reflected the interaction and synergism of the ECOs.

Following is a summary of the ECIP analysis for this building by taking synergistic effects into account.

ECO	COST (INCL. SIOH)	ENERGY SAVED (MBTU) ELEC.	OIL	TOTAL	ORIGINAL SIR	SYNERGISTIC SIR	SIMPLE PAYBACK
Radiator Control Valves	$ 945	0	25	25	3.8	3.3	3.7
Ceiling Insulation	530	2	7	9	3.5	3.2	4.7
Weather Stripping	723	0	21	21	2.1	1.7	2.5
Night Setback	1188	13	7	20	2.8	1.4	7.5
Reflectors	768	6	-2	4	1.3	1.3	6.2
Occupancy Sensors	121	1	0	1	0.8	0.5	13.3
Wall Insulation	36,826	1	29	31	0.2	0.2	95.0
Double-Insulated Glass	$ 5,129	0	4	4	0.2	0.2	98.0

10.13 Buildings 1-60 (General Officers' Quarters)

10.13.1 Building Description

General: There are 59 general officers' quarters. All of them are two storied units with basements and are of brick construction. Each unit has three to four bedrooms.

Mechanical Systems: Each unit, except Building 1, is heated by oil-fired steam boiler. Building 1 has an oil-fired hot water boiler. The boilers are about fifteen years old, with an expected remaining life of 5 years. Domestic hot water requirements are met by oil-fired water heaters which are at the end of their service lives. The boilers and hot water heaters are located in the basement.

Typical Units: For the purpose of this study, the units have been classified into the following four types based on their layouts.

A short description of each of the two typical units follows:

Type 1 — 4 bedrooms, a study, a maid's room, and two floors, totalling approximately 7,262 square feet. Also, there is a sun porch on first floor. (One unit.)

Type A — 4 bedrooms, a maid's room, and two floors, totalling approximately 4,803 square feet. Also, there is a sun porch on the first floor. (19 Units.)

Type B — 3 bedrooms and a sun porch on the first floor. Approximately 3,295 square feet. (18 Units.)

Type C — 3 bedrooms, sun porches on both levels. Approximately 3,575 square feet. (21 Units.)

10.13.2 ECOs Investigated

It is proposed to convert the energy source for heating and domestic hot water from the existing residual oil to natural gas. The energy usage for each typical unit was simulated by using the HAP20 program developed by Carrier Corporation. The ECIP analysis has been performed with these assumptions:

1. The economic life of residential boilers is 20 years.

2. The hot water heaters have an economic life of 10 years and will need replacement during the ECO's life after that period.

3. The main gas line will be installed by the gas company. Only the cost of gas lines from the curb into each unit will be borne by the Government.

10.13.3 ECIP Analysis Summary

	ENERGY SAVED (MBTU)				
COST (INCL. SIOH)	OIL	GAS	TOTAL	SIR	SIMPLE PAYBACK
$520,753	15,657	-14,050	1,607	1.3	12.3

10.14 Buildings 401-432 (Rossell Village)

10.14.1 Building Description

General: The study for Rossell Village is being carried out in the 400 area for 30 buildings (buildings 401-432), which have a total of 60 units. These buildings are multiple family units with two units per building and four types of units.

The buildings are two story consisting of 4 bedrooms in each unit. The buildings are brick frame construction and were built in 1955.

Mechanical Systems: The typical building (two units) is heated by an oil fired hot water boiler. The boilers are about 10 years old with a remaining life of 10 years. The domestic water heating is provided by oil fired water heaters which are at the end of their economic lives. The boiler and the water heater are located in the basement area.

Typical Units: For the purpose of this study, there are four different types of typical units. These typical units have been designated based on their location in the building and their size.

The description of the four typical units is as follows:

Type 1: 4 bedrooms, 2 floors, 1,849 total square feet, with approximately 600 square feet in the basement area.

Type 2: 4 bedrooms, 2 floors, 1,849 total square feet, with approximately 250 square feet in the basement area.

Type 3: 4 bedrooms, 2 floors, 2,089 total square feet, with approximately 600 square feet in the basement area.

Type 4: 4 bedrooms, 2 floors, 2,089 total square feet, with approximately 250 square feet in the basement area.

Building Configurations: There are two types of buildings based on the type of units in the building. For purposes of this study, the buildings have been designated as small building type or large building type, as follows:

Small Buildings

2 Units per building (Type 1 and 2). Each unit has 4 bedrooms and 2 floors with a total of approximately 1,849 square feet per unit.

Large Buildings

2 Units per building (Type 3 and 4). Each unit has 4 bedrooms, 2 floors, and a basement with a total of approximately 2,089 square feet per unit.

Totals: Small Buildings
Units 401 A, B through 405 A, B
Total = 5 Buildings (10 units)

Large Buildings
Units 406 A, B through 432 A, B
Total = 25 Buildings (50 units)

10.14.2 Fuel Conversion

Under this ECO the replacement of existing oil fired boilers and water heaters is evaluated. For this evaluation, the oil system has been designated as Alternative I and the gas system as Alternative II.

ALTERNATIVE I

This alternative refers to the existing oil fired boilers and domestic water heaters.

ALTERNATIVE II

This alternative assumes that the oil fired boilers are in good condition; and therefore, only the burners need to be changed in order to convert to gas. However, in about ten years, the boilers would have to be replaced.

In order to serve Rossell Village with gas, a distribution gas line will be installed by the gas company. Gas lines from the curb to each building including connections to the boiler and water heater will be provided by the Government.

10.14.3 ECIP Analysis Summary

	ENERGY SAVED (MBTU)				
COST (INCL. SIOH)	OIL	GAS	TOTAL	SIR	SIMPLE PAYBACK
$181,839	5,670	-5,995	-325	0.69	22.0

10.15 Buildings 900-944 (Dogue Creek Village)

10.15.1 Building Description

General: Dogue Creek Village consists of 45 buildings (Buildings 900-944) which have a total of 270 units. These buildings are multiple family units. There are 16 different configurations of the buildings and 10 different types of typical units.

Most of the units are two story, consisting of two or three bedrooms; the other units are one story. The buildings are of brick frame construction and were built in 1956.

Mechanical Systems: A typical unit is heated by an oil fired warm air furnace system. The existing oil furnaces are of downflow type. However, there is a possibility of changing to upflow furnaces in the future under another contract. Therefore, any new equipment evaluated should be taken into account. The fuel oil is supplied to the buildings from ten central 4,000 gallon tanks and from thirty-five 2,000 gallon tanks with pumped circulation systems. The domestic hot water is provided by an electrical water heater located next to the oil furnace.

Typical Units: There are 10 different types of typical units. These typical units have been designated based on typical locations, number of floors, number of bedrooms, and square footage.

The description of the 10 different typical units is as follows:

Description of Typical Unit

1. Dogue Creek, Type 1, Exterior 1

   2 bedroom, 2 floors, 1,137 square feet, exterior unit 1

2. Dogue Creek, Type 1, Interior

2 bedroom, 2 floors, 1,137 square feet, interior unit

3. Dogue Creek, Type 1, Exterior 2

2 bedroom, 2 floors, 1,137 square feet, exterior unit 2

4. Dogue Creek, Type 2, Exterior 1

3 bedroom, 2 floors, 1,264 square feet, exterior unit 1

5. Dogue Creek, Type 2, Interior

3 bedroom, 2 floors, 1,264 square feet, interior unit

6. Dogue Creek, Type 2, Exterior 2

3 bedroom, 2 floors, 1,264 square feet, exterior unit 2

7. Dogue Creek, Bungalow 1

3 bedroom, 1 floor, 1,264 square feet, bungalow unit 1

8. Dogue Creek, Bungalow 2

3 bedroom, 1 floor, 1,264 square feet, bungalow unit 2

9. Dogue Creek, Bungalow 3

2 bedroom, 1 floor, 1,137 square feet, bungalow unit 3

10. Dogue Creek, Type 4, Interior

2 bedroom, 2 floors, 1,189 square feet, interior unit

Building Configurations: There are 16 different types of building configurations. The configurations are based on number of units, type of units, size of units, and layout of the units for each building. The following is a listing of the building types, showing which buildings are in each category and the total size for each building configuration.

Building Type	Total Sq. Ft. Per Building
Type 1: Buildings 900, 924	5,812
Type 2: Buildings 902, 917	5,812
Type 3: Building 912	6,193
Type 4: Buildings 925, 931, 937	6,320
Type 5: Buildings 903, 910, 918, 927	6,320
Type 6: Buildings 901, 908, 916, 920, 935, 939	7,584
Type 7: Buildings 911, 923, 930, 942	6,320
Type 8: Buildings 904, 905, 906, 909, 921, 932, 943	6,320
Type 9: Building 926	7,076
Type 10: Building 915	5,812
Type 11: Buildings 913, 929, 941	6,320
Type 12: Building 944	6,320
Type 13: Building 928	9,604
Type 14: Building 922	5,056
Type 15: Buildings 914, 933, 934, 938	10,868
Type 16: Buildings 907, 919, 936, 940	10,868

10.15.2 Fuel Conversion

Under this ECO the conversion of existing oil furnaces and electric water heaters to gas fired furnaces and water heaters has been evaluated. The existing systems have been evaluated as Alternative I, and the proposed gas fired equipment has been designated as Alternative II.

A project is underway for renovation of the 900 area. This is Project No. 24566 and is called the Whole House Renovation Project, 900 Area. This project specifies changing the air duct system which is located in the slab to a location above the first story ceiling. Since the existing oil furnaces are downflow air type, this project will require changing the existing furnaces with an upflow air type furnace. Since this project requires changing the furnaces, only the incremental cost to change to a gas furnace is being considered in the economic analysis.

In order to serve Dogue Creek Village with gas, the existing 10" main gas line located along Mount Vernon Road will be tapped. A typical layout of the distribution gas line system will consist of a 4" line that will be installed at Gillespie Road until Barlow Road where a 3" line will be installed. Then, 2" lines will be installed around Fenner, Maloney, and Moyer Roads. A 1" line for each 2 units will be installed for each building. All of this work will be done by the gas company. Then, a 3/4" line will be installed inside each unit and connected to the furnace and water heater, which will all be paid for by the Government.

10.15.3 ECIP Analysis Summary

	ENERGY SAVED (MBTU)					
COST (INCL. SIOH)	ELEC	OIL	GAS	TOTAL	SIR	SIMPLE PAYBACK
$205,446	3,680	12,605	-16,308	-23	3.84	2.9

10.16 Buildings 2600-2787 (Woodlawn Village)

10.16.1 Building Description

General: Woodlawn Village consists of 143 buildings (Buildings 2600 to 2787) which have a total of 444 units. These buildings are multiple family units. There are five typical building configurations with five different types of typical units.

The buildings are two story with either two, three, or four units per building. The buildings are wood frame construction with siding and some face brick. The buildings were built in 1980-81.

Mechanical Systems: A typical unit is heated and cooled with a split-system electric heat pump. The heat pumps are about 10 years old with an expected remaining life of 5 years. The domestic water heating is provided by an electric water heater which is at the end of its service life. The indoor section of the heat pump and the water heater are located in a closet type area. The heat pumps and domestic water heaters appear to be in good condition.

Typical Units: There are 5 different types of typical units. These typical units have been designated based on their location in the building and their size.

The description of the five typical units is as follows:

Type 1 - Upstairs Unit

2 bedroom, 1 floor, 1,452 square feet

Type 1 - Downstairs Unit

2 bedroom, 1 floor, 1,452 square feet

Type 2 - Exterior Unit

4 bedroom, 2 floors, 1,852 square feet

Type 2 - Interior Unit

4 bedroom, 2 floors, 1,852 square feet

Type 3

4 bedroom, 2 floors, 2,073 square feet

Building Configurations: There are five types of buildings based on the type of units in the building and the number of units per building, as follows:

Typical Building 1

This type of building has 4 units with each unit having 1,452 square feet, with the following units:

Typical Unit 1 - Upstairs, 2 units in the building
Typical Unit 1 - Downstairs, 2 units in the building

Typical Building 2

This type of building has 2 units with each unit having 1,852 square feet, with the following units:

Typical Unit 2 - Exterior, 2 units in the building

Typical Building 3

This type of building has 4 units with each unit having 1,852 square feet, with the following units:

Typical Unit 2 - Exterior, 2 units in the building
Typical Unit 2 - Interior, 2 units in the building

Typical Building 4

This type of building has 2 units, with each unit having 2,073 square feet, with the following units:

Typical Unit 3 - 2 Units in the building

Typical Building 5

This type of building has 3 units, with each unit having 1,852 square feet, with the following units:

Typical Unit 2 - Exterior, 2 units in the building
Typical Unit 2 - Interior, 1 unit in the building

10.16.2 Fuel Conversion

Under this ECO the replacement of existing electric heat pumps, and water heaters by gas fired furnaces and water heaters is considered. For this analysis, the existing all electric system is considered as Alternative I and the proposed gas fired equipment is considered in Alternatives IIA and IIB.

Under Alternatives IIA and IIB, the existing electric heat pumps will be removed and a gas furnace will be installed for heating and new air conditioners will be installed for cooling. The existing electric domestic water heaters will be replaced with gas fired domestic water heaters. Under Alternative IIA conventional gas furnaces with an efficiency of 84% were evaluated while Alternative IIB evaluated high efficiency (92%) furnaces.

In order to serve Woodlawn Village with gas, a distribution gas line will be installed. A typical line layout of the distribution will consist of a 4" line around Plantation Drive, with 3" lines tapping into it for the various courts. A 2" line will be installed around each court and a 1" line will be installed for each 2 units for each building. Then a 3/4" line will be installed inside each unit to be connected to the furnace and water heater. In addition, it will be necessary to install a vent chimney for the gas furnace and water heater which will require some architectural modifications.

10.16.3 ECIP Analysis Summary

		ENERGY SAVED (MBTU)				
	COST (INCL. SIOH)	ELEC	GAS	TOTAL	SIR	SIMPLE PAYBACK
Alternative IIA	$1,864,793	17,205	-26,596	-9,391	0.72	11.6
Alternative IIB	$2,757,556	13,577	-21,468	-7,891	19.0	19.0

10.17 Summer Steam Use Evaluation

In the 300 area buildings, namely building numbers 307, 309, 317, 327, 331, 334, 357, 362, 363, and 365, summer steam requirements were evaluated. Four alternatives were considered and are as follows:

Alternative 1. Install a new boiler at the central heating plant #332 to handle only the summer load allowing the large boiler to be shut down.

Alternative 2. Install a new boiler at each building for summer load allowing central heating plant #332 to be shut down.

Alternative 3. Install a new steam and condensate main, sized for summer load, from the central heating plant #1422 to the 300 area distribution system allowing the central plant #332 to be shut down.

Alternative 4. Install a new steam and condensate main, sized for year-round load, from the central heating plant #1422 to the 300 area allowing the central plant #332 to be permanently closed.

Alternative 1 was discounted as a viable ECO when the computer estimated peak loads for the ten buildings indicated, selection of a new central plant boiler for mid-April through mid-October use to be within twenty percent of the boiler horse power of the smallest existing boiler in the 300 area plant. It was evident that the possible savings that would result from this alternative would not justify an addition to the plant or even the removal of an existing boiler and replacement with a boiler sized for the summer steam requirement.

Alternative 2 proposes the installation of a local boiler at each building, sized for the non-heating months, allowing the 300 area central heating plant at Building 332 to be shut down for half the year. Buildings 309, 327, 331, 357, 363, and 365 require the construction of a small mechanical room addition, adjacent to the existing building, to house the required heating equipment. Buildings 307, 317, and 362 appear to have adequate space in their existing mechanical equipment rooms to house the summer heating equipment. Building 334 will have an oil fired hot water heater installed in a space currently used for storage. A masonry partition with a labeled door is proposed, creating a small equipment room. Underground oil storage tanks with leak detection equipment is proposed for all buildings except 331 and 365.

Investigation revealed that eight of the buildings use sufficient summer steam to warrant local boiler placement. Buildings 334 and 365 only use summer steam for domestic hot water heating for which oil fired hot water heaters are proposed for the non-heating months.

Alternatives 3 and 4 did not meet the ECIP qualification tests and are therefore not recommended.

During the compilation of final data for these alternatives it became evident that a discrepancy existed between steam produced vs. steam being used in the ten buildings listed during the non-heating months. Subsequent inquiries directed to the base energy office about the possibility of additional 300 area buildings using steam during the non-heating months brought a response, after checking, that seven other buildings were believed to require steam all year for domestic hot water heating. The energy used by these additional buildings has been excluded and the addition of summer water heaters should not affect the ECIP tremendously. However, it is suggested that the additional seven buildings be investigated before Alternative 2 is implemented.

Following is the summary of ECIP analysis:

		ENERGY SAVED (MBTU)					
ECO	COST (INCL. SIOH)	ELEC.	RESID. OIL	DIST. OIL	TOTAL	SIR	SIMPLE PAYBACK
Local Boilers	$575,562	566	49,595	-19,702	30,459	11.6	2.1
1422-300 Area Summer	1,368,180	658	-1,595	-	-937	.69*	18.9
1422-300 Area Year-Round	1,465,057	1,052	-4,677	-	-3,625	1.2*	10.4

* Does not meet ECIP non-energy qualification test.

APPENDIX A
SCOPE OF WORK

SCOPE OF WORK
FOR AN
ENERGY SAVINGS OPPORTUNITY SURVEY (ESOS)

ENERGY ENGINEERING ANALYSIS PROGRAM

Fort McNair, Washington, DC

Fort Myer, VA

Fort Belvoir, VA

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1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (AE) shall:

1.1 Review for general information the previously completed Energy Engineering Analysis Program (EEAP) study and any other energy studies which were performed at this installation.

1.2 Reevaluate selected projects and energy conservation opportunities (ECOs) from the previous studies to determine their economic feasibility based on revised criteria, current site conditions and technical applicability.

1.3 Evaluate selected ECOs to determine their energy savings potential and economic feasibility.

1.4 Perform a limited site survey of selected buildings as detailed in Annexes A1, A2, & A3 ~~as required~~ to insure that any specific methods of energy conservation which are practical and have not been evaluated in any previous energy study have been considered and the results documented.

1.5 Provide complete programming or implementation documentation for all recommended ECOs.

1.6 Prepare a comprehensive report to document the work performed, the results and the recommendations.

2. GENERAL

2.1 Other studies performed under the EEAP have been performed at this installation. Criteria for both the study and the resulting documentation has changed since the previous study was completed. This study is intended to reevaluate selected projects from the previous study which have not been implemented nor programmed for implementation and to consider specific ECOs in buildings and areas that may have been overlooked previously or recently identified.

2.2 The information and analysis outlined herein are considered to be minimum essentials for adequate performance of this study.

2.3 The AE shall ensure that all methods of energy conservation which will reduce the energy consumption of the installation in compliance with the Energy Resources Management Plan including those listed in Annexes A1, A2, & A3 have been considered and documented. All methods of energy improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination. ~~A list of general conservation opportunities (ECOs) to be used when evaluating specific buildings or areas is included as Annexes A1, A2, & A3.~~ conservation which are reasonable and practical shall be considered including

~~A3 to this scope~~. Annexes A1, A2, and A3 contain a list of ECOs specifically for this installation. ~~[redacted] of~~ These lists shall be considered and the evaluation of each ECO documented in the report. ~~These lists are not intended to be restrictive but only to assure that basic and generally repetitive opportunities are addressed in the report. Some of the energy conservation opportunities in Annexes A, B, & C may not be applicable to the specific building or area at this installation. A statement to that effect is all that is required.~~

2.4 The study shall include the energy consuming buildings or areas listed in Annexes A1, A2, & A3. The work in the areas may be reduced somewhat by building repetition.

2.5 The study shall consider the use of all energy sources. The energy sources may include electricity, natural gas, liquefied petroleum gas, bulk oil, other oil products, steam when procured, gasoline, coal, solar, etc.

2.6 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from CEHSC-FU, dated 25 April 1988 (CEHSC-FU-P, 15 June 89) establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. Construction cost escalation for DD Form 1391 sub mission shall be calculated using the guidelines contained in AR 415-17 and the latest Tri-Service MCP Index. The Tri-Service MCP Index, when updated, is contained in the latest applicable edition of the Engineer Improvement Recommendation System (EIRS) bulletin.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP or MCA funding, and determining, in coordination with installation personnel, the appropriate packaging and implementation approach for all feasible ECOs.

2.8 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.9 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

~~2.10 At some installations Energy Conservation and Management~~ (ECAM) ~~funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Engineering and Housing will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant.~~

3. PROJECT MANAGEMENT

3.1 Project Managers. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract.

The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

3.2 Installation Assistance. The Commanding Officer at each installation will designate an individual who will serve as the point of contact for obtaining information and assisting in establishing contacts with the proper individuals and organizations as necessary to accomplish the work required under this contract.

3.3 Public Disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE and/or the designated representative(s) shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

3.5 Site Visits, Inspections, and Investigations. The AE shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records

3.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

3.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of material.

3.7 Interviews. The AE and the Government's representative shall conduct entry and exit interviews with the Director of Engineering and Housing before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall thoroughly brief and describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

a. Schedules.

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the Director of Engineering and Housing.

3.7.2 Exit. The exit interview shall include a thorough briefing describing the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Engineering and Housing.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor, superintendence and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All energy conservation opportunities (ECOs) which the AE has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $200,000, a Savings to Investment Ratio (SIR) greater than one and a simple payback period of less than eight years. For ECAM and family housing projects, the $200,000 limitation may not apply. The AE shall check with the installation for guidance. The overall project and each discrete part of the project shall have a SIR greater than one. For all projects meeting the above criteria, complete programming documentation will be required. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis summary sheet(s) (with necessary backup data to verify the numbers presented), and a project development brochure (PDB). A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO is combined. For projects and ECOs reevaluated from the previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages revising the original calculations and analysis. In addition, the backup data shall include as much of the following as is available: the increment of work the project or ECO was developed under in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. This information shall be included as part of the backup data. The purpose of this information is to provide a means to preveht duplication of projects in any future reports.

5.2 Non-ECIP Projects. Projects which normally do not meet ECIP criteria, but which have an overall SIR greater than one shall be documented. The life cycle cost analysis summary sheet shall be completed through and including line 6 for all projects or ECOs. Each shall be analyzed to determine if they are feasible even if they do not meet ECIP criteria. These ECOs or projects may not meet the nonenergy qualification test. For projects or ECOs which meet this criteria, the life cycle cost analysis summary sheet, completely filled out, with all the necessary backup data to verify the numbers presented, a complete description of the project and the simple payback period shall be included in the report. Additionally, these projects shall have the necessary documentation prepared, in accordance with the requirements of the Government's representative, for one of the following categories:

a. Quick Return in Investment Program (QRIP). This program is for projects which have a total cost less than $100,000 and a simple payback period of two years or less.

b. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost greater than $100,000 and a simple payback period of four years or less.

c. Productively Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost greater than $100,000 and a simple payback period of four years or less.

The above programs are all described in detail in AR 5-4, Change No. 1.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $200,000 and a simple payback period of eight to twenty-five years. Projects or ECOs which qualify for this program shall be economically analyzed in accordance with the requirements for Special Directed Studies in Engineering Technical Letter (ETL) 1110-3-332.

e. Low Cost/No Cost Projects. These are projects which the Director of Engineering and Housing can perform using his resources.

5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The general Scope of Work is intended to apply to contract efforts for all Army installations included under this contract except as modified by the detailed Scope of Work for each individual installation. The detailed Scope of Work is contained in Annexes A1, A2 & A3

7. WORK TO BE ACCOMPLISHED.

7.1 Review Previous Studies. The AE shall review for general information the previous EEAP study along with any other energy studies performed at the installation. This review should acquaint the AE with the work that has been performed previously. Much of the information the AE may need to develop the

ECOs in this project will be contained in the previous studies. The survey data contained in the previous study should be very helpful to the results of this study.

7.2 Reevaluate Selected Projects. The AE shall reevaluate the projects and ECOs listed in Annexes A1, A2, & A3. These projects and ECOs are projects and ECOs that the previous study has identified but that have not been accomplished or only parts have been accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information the project shall then be analyzed based on current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy saving, the energy costs and construction costs shall be updated and the revised project or ECO shall then be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected of being inaccurate, but the project or ECO is still considered feasible, the AE shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the report.

A1, A2 & A3 7.3 Evaluate Selected ECOs. The AE shall analyze the ECOs listed in Annex B. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined using current ECIP guidance. The necessary data required for these projects may not be available, requiring the AE to visit the installation to obtain any necessary information. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data. For ECOs which would replace the existing heating, ventilating, and air conditioning (HVAC) system or significantly change it (such as converting a multizone system to a variable air volume (VAV system)) the AE is required to run a computer simulation to analyze the system and to determine the energy savings. This requirement to use computer modeling applies only to heated and air conditioned or air conditioned only buildings which exceed 8,000 square feet or heated only buildings in excess of 20,000 square feet. The computer program shall analyze the building on an hour-by-hour basis rather than the bin data method or bin data to simulate an hour-by-hour analysis. Unless the Building Loads Analysis and System Thermodynamic (BLAST) program is used, the AE shall submit a sample computer run with an explanation of all input and output data and a summary of program methodology and energy evaluation capabilities for approval by the Contracting Officer prior to use of the program for analysis. The computer program used must be comparable to the BLAST program. The use of the LCCID computer program may be used if requested in writing.

7.4 Perform a Limited Site Survey. The AE shall conduct a limited site survey to evaluate the buildings or areas listed in Annexes A1, A2, & A3. The list of ECOs in Annexes A1, A2, & A3 shall be used when evaluating these building or areas. This list is not intended to be restrictive but only to assure that these opportunities, as a minimum, are considered, discussed and documented in the report. The AE may be aware of other ECOs not included in Annexes A1, A2, & A3 that will produce energy, manpower or dollar savings. These should be evaluated the same4 as the other ECOs. Each of the items shall be considered and discussed in the report. Those items on the list which are not practical, have been previously accomplished, are inappropriate or can be eliminated from detailed analysis based on preliminary analysis shall be listed in the report along with the reason for elimination from further analysis. All potential ECOs which are not eliminated by preliminary considerations shall be thoroughly documented and evaluated as to technical and economic feasibility. The AE shall obtain all the necessary data to evaluate the ECOs by conducting a site survey. However, the AE is encouraged to use any data that may have been documented in a previous study. The AE shall document his site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.5 Provide Programming or Implementation Documentation. For projects or ECOs reevaluated or developed during this study, complete programming or implementation documentation shall be prepared by the AE.

7.5.1 Programming Documentation. For projects or ECOs which meet ECIP criteria and which the installation wants to submit as an ECIP project, complete programming documentation shall be prepared. Complete programming documentation consists of DD Form 1391, Project Development Brochure (PDB) and supporting data. These forms shall be separate from the narrative report. They shall be bound similarly to the final report in a manner which will facilitate repeated disassembly and reassembly.

7.5.1.1 Military Construction Project Data (DD Form 1391). These documents shall be prepared in accordance with AR 415-15 and the supplemental requirements in Annex C. A complete DD Form 1391 shall be prepared for each project. The form shall include a statement that the project results from an EEAP study. Documents shall be complete as required for submission to higher DA headquarters. These programming documents will require review and signatures by the proper installation personnel. All documents shall be completed except for the required signatures.

7.5.1.2 Project Development Brochure (PDB). Preparation of the PDB requires the AE to delineate the functional requirements of the project as related to the specific site. The AE shall prepare PDBs in accordance with AR 415-20 and TM 5-800-3. Most projects will not require all4the forms and checklists included in the Technical Manual (TM). Only that information needed for the project shall be included. The PDB-I format described in the TM shall be used for whatever information is needed.

7.5.2 Implementation Documentation. For feasible projects or ECOs which normally do not meet ECIP criteria, implementation documentation shall be prepared. Each feasible project or ECO shall be individually packaged and fully documented and included as a separate section in the volume containing the programming documentation. Each project or ECO shall have a complete description of the changes required, economic justifications, sketches, and other backup data included as a section in the report. The documentation required will be as determined by the Government's representative. Documentation required will be in the categories listed in paragraph 5.2. For the QRIP, OSD PIF and PECIP projects, documentation shall be prepared in accordance with the requirements of AR 5-4, Change No. 1. A sample implementation document, consisting of a DA Form 5108-R, sketches and manufacturers data and a life cycle cost analysis summary sheet shall be submitted for review and approval. This sample shall be submitted with the interim submittal. This sample shall be approved before any other implementation documents are prepared. To the degree possible, the project or ECO selected for the sample submission shall be typical of the majority of subsequent projects to be submitted. The sample shall consist of complete implementation documents with primary emphasis on format and manner of presentation rather than precise accuracy of cost estimates and energy savings data. For MCA projects the documentation required shall be in accordance with paragraph 7.5.1 except that the economic analysis required by ETL 1110-3-332 shall be included in lieu of the ECIP life cycle cost analysis. For low cost/no cost projects which the Director of Engineering and Housing personnel can perform, the following information shall be provided:

a. Brief description of the project.

b. Brief description of the reasons for the modification.

c. Specific instructions for performing the modification.

d. Estimated dollar and energy savings per year.

e. Estimated manhours and labor and materials costs. Costs shall be calculated for the current calendar year and so marked. Manhours shall be listed by trade. For projects that would repair an existing system so that it will function properly, also include the estimated manhours by trade and labor and material costs necessary to maintain the system in that condition. Some of the simple practical modifications may be developed on a per unit basis. An example of this type of modification would be the repair or replacement of steam traps on an as needed basis. As a rule, however, the AE should develop complete projects, if at all possible, rather than per unit modifications. Separate sheets for each project showing the above information shall be prepared and included in the report.

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. The AE shall give a formal presentation of all but the final submittal to installation, command, and other Government personnel. During the presen-

tation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. The AE shall provide the comments from all reviewers and written notification of the action taken on each comment to all reviewing agencies within three weeks after the review meeting. It is anticipated that each presentation and review conference will require approximately one working day. The presentation and review conferences will be at the installation on the date(s) agreeable to the Director of Engineering and Housing, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after completion of the field survey and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings and SIRs of all the ECOs shall be included. The simple payback period of all ECOs shall be calculated and shown in the report. The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. During the review period, the Government's representative shall coordinate with the Director of Engineering and Housing and provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. A sample implementation document (DA Form 5108-R, sketches and manufacturers data, life cycle cost analysis summary sheet and supporting data) for one project shall be submitted with this submittal for review and approval. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Prefinal Submittal. The AE shall prepare and submit the prefinal report when all work under this contract is complete. The AE shall submit the Scope of Work for the installation studied and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The report shall include an order of priority by SIR in which the recommended ECOs should be accomplished. The synergistic effects of all of the ECOs on one another shall have been determined and the results of the original calculations adjusted accordingly. Completed programming and implementation documents for all recommended projects shall be included. The programming and implementation documents shall be ready for review and signature by the installation commander. The prefinal

report, separately bound Executive Summary and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The prefinal submittal shall be arranged to include (a) a separately bound Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex D for minimum requirements), (b) the narrative report containing a copy of the Executive Summary at the beginning of the volume and describing in detail what was accomplished and the results of this study, (c) appendices to include the detailed calculations and all backup material and (d) the programming and implementation documentation. A list of all projects and ECOs developed during this study shall be included in the Executive Summary and shall include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost.

7.6.3 Final Submittal. Any revisions or corrections resulting from comments made during the review of the prefinal report or during the presentation and review conference shall be incorporated into the final report. These revisions or corrections may be in the form of replacement pages, which may be inserted in the prefinal report, or complete new volumes. Pen and ink changes or errata sheets will not be acceptable. If replacement pages are to be issued, it shall be clearly stated with the prefinal submittal that the submitted documents will be changed only to comply with the comments made during the prefinal conference and that the volumes issued at the time of the prefinal submittal should be retained. Failure to do so will require resubmission of complete volumes. If new volumes are submitted, they shall be in standard three-ring binders and shall contain all the information presented in the prefinal report with any necessary changes made. Detailed instructions of what to do with the replacement pages should be securely attached to the replacement pages.

ANNEX A3

Detailed Scope of Work

for an

Energy Savings Opportunity Survey (ESOS)

at

Fort Belvoir, Virginia

Pages A-1 thru A-6

The following detailed requirements amplify, modify, or add to the referenced paragraphs of the General Scope of Work for the subject study.

1. 2.6 Use an SIOH value of 5.5% in ECIP Guidance, Life Cycle Cost Analyses.

2. 3.0 Add the following:

Point of contact for Ft. Belvoir, VA is:

Commander
U.S. Army Military District of
Washington
ATTN: ANEN-RM, (Mrs. Joan Johnson)
Fort Lesley J. McNair, Washington DC
20319-5050

Point of contact at Baltimore District is:

COMMANDER
U.S. Army Engineer District, Baltimore
ATTN: CENAB-EN-D (Mr. James Hawk)
P.O. Box 1715
Baltimore, Maryland 21203-1715

3. 7.5.1.2 Delete all contract requirements for a Project Development Brochure (PDB) at this installation.

4. 7.5.2 The fiscal year to which all projects should be estimated for programming or implementation documents shall be ~~FY 92~~ determined at the interim review conference.

5. 7.6 Add the following schedule requirements: The work and services to be provided by the contractor under this contract shall be performed within the indicated number of calendar days:

a.	NTP to Interim Submittal Report	122 Days
b.	Interim Review Conference	163 Days
c.	Interim Report Approval	164 Days
d.	Prefinal Submittal	250 Days
e.	Prefinal Review Conference	293 Days
f.	Prefinal Approval	294 Days
g.	Final Submittal	324 Days

6. 7.6.3 ~~All calculations for the final report to the using agency shall be submitted on a spreadsheet format floppy disk. The format will be determined during negotiations. The final report to the using agency shall consist of three hard copies.~~ A copy of the final report shall be sent to the Mobile District, Mobile, AL, in addition to item 9 after final approval

7. 7.6.4 Submittals of reports and minutes shall be transmitted directly to the agencies listed below in the quantities noted. An informational copy of all transmittal letters, shall be provided to CENAB-EN-D.

Agency	Reports	Minutes
USALEA, DALO-LEP	A	-----
USACE, CEEC-EE	A	-----
CENAB-EN-D	3	2
CENAD-EN-MM	A	1
ANEN-RM	5	1

Submittals will be mailed to : "A" - Executive Summary Only

COMMANDER
USALEA
ATTN: DALO-LEP (Mr. Keath)
NCAD
New Cumberland, PA 17070-5007

COMMANDER
HQUSACE
ATTN: CEEC-EE (Mr. Beranek)
Washington, DC 20314

COMMANDER
U.S. Army Engineer District, Baltimore
ATTN: CENAB-EN-D (Mr. Hawk)
P.O. Box 1715
Baltimore, MD 21203-1715

~~COMMANDER~~
USAED, North Atlantic
ATTN: CENAD-EN-MM (Mr. Elkstrems)
90 Church Street
New York, NY 10007

COMMANDER
U.S. Army Military District of Washington
DCSEH ATTN: ANEN-RM (Mrs. Joan Johnson)
Fort Lesley J. McNair
Washington, DC 20319-5050

8. The buildings and ECO's to be surveyed are listed on the enclosed matrix. Clarification notes for the ECO's are as follows:

a. Alternate Fuel Study - The existing buildings are heated and cooled with electric heat pumps. The A/E shall investigate all ECO's to determine if these buildings can be economically heated by gas and utilizing the existing heat pumps for air-conditioning. A/E shall investigate all ECO's to determine if it is economical to install FM switches or exterior sensors for heating and hot water heaters.

b. FM Switches - The existing central air-conditioning units are not part of the post energy monitoring control system. The A/E shall investigate all ECO's to determine if is it economical to install FM Switches on these units or to incorporate them into the posts energy monitoring control system.

c. Dual Fuel - The A/E shall investigate all ECO's to determine if these boiler plants can be economically fueled by using dual fueled boilers. A/E shall determine efficiency ~~and measure condensate return~~ in his investigation of these ECO's. The A/E shall include in these ECO's any savings by increasing the number of control points presently connected into the post's EMCS.

d. Low Pressure Boilers - Existing buildings require high pressure steam for air-conditioning. A/E shall investigate all ECO's to determine if these buildings can be economically cooled by installing a low pressure boiler for summer cooling and hot water.

e. Model Buildings - A/E shall model these buildings to determine energy efficiency and potential energy savings in accordance with paragraph 7.4 of the Scope of Work.

f. Ice Production Storage - A/E shall investigate all ECO's to determine if this process can economically reduce the peak demand of electrical use during the cooling season.

g. Stand by Generators - A/E shall investigate all ECO's to determine if this process can economically reduce the peek demand of electrical use during the cooling season.

h. Evaluation of Boiler Study - Reevaluate the ECO's of this study and determine the up to date economic savings to the Government.

Delete

~~i. Steam Distribution System - Survey the distribution system from~~ boiler houses 332 and 1422. Identify all ECO's to determine if efficiency can be improved by the repair addition modification of equipment control systems, operations, maintenance practices, and recommended improvements. The A/E shall be responsible for all excavation, restoration of property, furnish and installation of all testing of measurement equipment or devices.

j. Boiler Plant Study - Survey the boiler plant to determine if efficiency can be improved by the repair, addition, or modification of equipment, control systems and operation and maintenance practices and recommend improvements. Identify all ECO's to determine if efficiency can be improved. The A/E is responsible to furnish and install all testing of measurement equipment or devices. This plant is operational all year round. Outages must be scheduled 14 days in advance.

k. Alternate Fuel Study - The existing buildings are heated by oil. The A/E shall investigate all ECO's to determine if these buildings can be economically heated by gas. A/E shall investigate all ECO's to determine if it is economical to install FM switches or exterior sensors for heating and hot water heaters

l. All work in these buildings must be scheduled 10 days in advance.

m. Drawings for these buildings may be reviewed at Building 1442 at Fort Belvoir, VA. P.O.C. is Mr. Paul Bruegueras at telephone number (703) 664-6251 between the hours of 9 a.m. and 3 p.m.

ITEMS OF STUDY OR ENERGY SAVINGS OPPORTUNITIES	BUILDINGS																			
			307	309	317	327	331	334	357	362	363	365	505A	1359 CONTROL	WOODLAWN HSG 2600 TO 2787	RUSSELL VILLAGE 401 TO 432	GEN OFFICERS QTRS 1 TO 60	DOUGE CREEK HSG 900 TO 944	PRIORITY
DUEL FUEL OIL AND GAS																			
FM SWITCHES VERSUS EMCS																			
OIL TO GAS ALTERNATE FUEL																X	X	X	
NATURAL GAS OR #2 FUEL OIL STAND-BY GENERATORS													X						
WASTE DISPOSAL REVIEW																			
DEWITT ARMY HOSPITAL REPORT COMPLETION																			
ELECTRIC TO GAS ALTER-NATE FUEL STUDY															X				
CENTRAL LOW PRESSURE BOILER			X	X	X	X	X	X	X	X	X	X							
COMPUTER MODEL														X					
ICE PRODUCTION STORAGE																			
ENERGY STUDY																			

ANNEX B

REQUIRED DD FORM 1391 DATA

To facilitate project approval, the following supplemental data shall be provided:

a. In title block clearly identify projects, e.g. ECIP, ORIP, etc.

b. Complete description of each item of work to be accomplishec including quantity, square footage, etc.

c. A comprehensive list of buildings, zones or areas including building numbers, square foot floor area, designated temporary or permanent, and usage (administration, patient treatment, etc.)

d. List references, and assumptions, and provide calculations to support dollar and energy savings, and indicate any added costs.

e. Each project shall be keyed to identify maintenance and new work costs.

(1) If a specific building, zone, or area is used for sample calculations, identify building, zone or area, category, orientation, square footage floor area, window and wall area for each exposure.

(2) Identify weather data source.

(3) Identify infiltration assumptions before and after improvements.

(4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.

f. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.

g. Lighting retrofit projects must identify number and type of fixtures, and wattage of each fixture being deleted and installed. New lighting shall be only of the level to meet current criteria. Lamp changes in existing fixtures is not considered an ECIP type project.

ANNEX C

EXECUTIVE SUMMARY GUIDELINE

1. Introduction

2. Building Data (types, number of similar buildings, sizes, etc.)

3. Present Energy Consumption.

   a. Total Annual Energy Used.

   b. Source Energy Used.

      Electricty - KWH, Dollars, BTU

      Fuel Oil - GALS, Dollars, BTU

      Natural Gas - THERMS, Ddollars, BTU

      Propane - GALS, Ddollars, BTU

      Other - QTY, Dollars, BTU

4. Energy Conservation Analysis.

   . ECOs Investigated.

   . ECOs Recommended.

   . ECOs Rejected. (Provide economics or reasons)

   . ECIP Projects Developed. (Provide list)*

   . Non-ECIP Projects Developed. (Provide list)*

   . Operational or Policy Change Recommendations.

* Include the following data from the Life Cycle Cost Analysis Summary Sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR and the the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost. Show the simple payback period for all ECOs.

5. Energy and Cost Savings.

   - Total Potential Energy and Cost Savings.
   - Percentage of Energy Conserved.
   - Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

6. Energy Plan.

   - Project Breakouts with Total Cost and SIR.
   - Schedule of Energy Conservation Project Implementation

ANNEX D

GOVERNMENT-FURNISHED DATA

1. The following data shall be furnished by the Government for use on this project:

(a) Energy Resource Management Plan. ✓

NOT IN SERVICE

(b) ~~ETLs 1110-3-254, Use of Electric Power for Comfort Space~~ Heating; 1110-3-282, Energy Conservation; and ~~1110-3-332,~~ [redacted] ECONOMIC STUDIES

(c) Energy Conservation Investment Program (ECIP) Guidance, dated 25 April 1988; CEHSC-FU-P 15 June 89,

(d) TM 5-785, Engineering Weather Data, TM 5-800-2, General Criteria Preparation of Cost Estimates, TM 5-800-3, Project Development Brochure.

(e) ~~AR 415-15~~, Military Construction Army (MCA) Program Development, AR 415-17, Cost Estimating for Military Programming; AR 415-20, Construction, Project Development and Design Approval; AR 415-28, Department of the Army Facility Classes and Construction Categories; AR 415-35, Construction, Minor Construction; AR 420-10, General Provisions, Organization, Functions, and Personnel; AR 11-27, Army Energy Program; and AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

(f) The latest applicable Engineer Improvement Recommendation System (EIRS) bulletin, for purposes of cost estimation.

(h) An example of a correctly completed implementation document for a non-ECIP project.

APPENDIX B
FUEL RATES

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

I. APPLICABILITY

This schedule is applicable to any Federal Government installation contracting for 1500 kW or more of alternating current electricity. Such installation served under this schedule may change to service under the Company's Schedule No. 6 - Large General Service, and vice versa, effective with the meter reading date immediately preceding the receipt by the Company of the Government's written request for such change, if (1) the initial term of the applicable schedule has been satisfied; or (2) a change is made in the rate for service under either schedule. However, when an installation makes such change, the installation must remain on the then-selected schedule for at least one year after the change is made, regardless of changes in either rate schedule during such one-year period, other contract provisions to the contrary notwithstanding.

II. SERVICE AVAILABLE

The Company will supply the equipment necessary and will deliver to the Customer at a delivery point mutually satisfactory to the Customer and the Company, 60 hertz alternating current electricity of the phase and Company standard nominal voltage desired by the Customer at said delivery point, provided electricity of the phase and voltage desired by the Customer is available generally in the area in which electricity is desired.

III. 30-DAY RATE

A.	KW Demand Charge First 1500 kW of Demand or Less Additional kW of Demand	 @	$16,683.78 $ 10.78 per kW
B.	Plus rkVA Demand Charge All rkVA of Demand	@	$ 0.15 per rkVA
C.	Plus Energy Charge All kWh	@	2.165¢ per kWh

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

D. Annual Fuel Adjustment Factor

1. The kilowatthours in each customer's bill for the current billing month shall be multiplied by an annual fuel adjustment factor which shall be equal to the sum of:

(a) the estimated current-period fuel adjustment factor, and

(b) the prior-period deferral adjustment factor.

2. The estimated current-period fuel adjustment factor to become effective with the April billing month of each year shall be based on the total estimated system fuel expenses allocable to Schedule MS and Schedule MS kilowatthour sales for the 12-month period beginning in April of each year, and shall be calculated by the fuel adjustment factor formula shown below rounded to the nearest thousandth of a cent.

3. The prior-period deferral adjustment factor to become effective with the April billing month of each year shall be based on the difference between the total fuel expenses (using the criteria outlined in (a) through (c) of paragraph 7. below) allocable to Schedule MS and the total fuel recoveries by Schedule MS customers for the 12 months prior to April of each year, divided by the estimated Schedule MS kilowatthour sales for the 12-month period beginning with April of each year (6 months where a semi-annual change is made pursuant to paragraph 5. below). The prior-period deferral adjustment factor will be adjusted for taxes.

4. The intent of the annual fuel adjustment factor is to recover all fuel expenses allocable to Schedule MS customers. To the extent the amount recovered from Schedule

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

MS customers through annual fuel adjustment factors and the fuel component of the base rate exceeds the cost of fuel allocable to Schedule MS for the same time period, this over-recovery shall be a credit in the calculation of the prior-period deferral adjustment factor for the 12-month period beginning with the next April. To the extent the amount recovered from Schedule MS customers through the annual fuel adjustment factor and the fuel component of the base rate is less than the cost of fuel allocable to Schedule MS for the same time period, this under-recovery shall be a charge in the calculation of the prior-period deferral adjustment factor for the 12-month period beginning with the next April.

5. The annual fuel adjustment factor shall be reviewed on a semi-annual basis to determine if any change is required. The current and prior period portions of the fuel adjustment factor will be reviewed individually, and a change to one or both may be made. The adjustment may be deferred until the end of the 12-month period, provided the net difference between the Company's actual and estimated under-recovery at the end of the 12-month period is no greater than seven and one-half per centum of actual and estimated fuel expenses or the net difference between the actual and estimated over-recovery at the end of the 12-month period is no greater than five per centum of actual and estimated fuel expenses.

6. Fuel adjustment factor formula:

$$F = \left[\frac{(E_1 + E_2)}{S} - B \right] (T) \ (100)$$

Where:

F = Estimated fuel - adjustment factor in cents per kilowatthour.

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

E_1 = Estimated North Anna fuel expenses plus estimated Old Dominion Electric Cooperative Buyback fuel expenses allocated to Schedule MS Customers.

E_2 = Estimated total fuel expenses less estimated North Anna fuel expenses and Old Dominion Electric Cooperative Buyback fuel expenses allocated to Schedule MS Customers.

S = Estimated total Schedule MS kilowatthour sales for the 12-month period beginning with April each year.

B = Base cost of fuel per kWh sold adjusted for line loss.

T = Adjustment for state and local taxes measured by gross receipts: 100% divided by (100% minus applicable gross receipts tax rate).

7. The estimated fuel expenses allocable to the Schedule MS Customers for 12-month period beginning April of each year, determined as follows:

(a) Fossil and nuclear fuel consumed in the Utility's own plants, and the Utility's sharge of fossil and nuclear fuel consumed in jointly owned or leased plants.

The cost of fossil fuels shall be those items initially charged to account 151 and cleared to accounts 501, 518 and 547 on the basis of fuel used. In those instances where a fuel stock account (151) is not maintained, e.g., gas for combustion turbines, the amount shall be based on the cost of fuel consumed and entered in account 547.

The cost of nuclear fuel shall be the amount contained in account 518 except that if account 518 also contains any expense for fossil fuel which has already been included in the cost of fossil fuel, it shall be deducted from this account.

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

Plus

(b) The following purchased power costs:

(i) The fuel cost component of any purchased power transaction.

or

(ii) The total energy charges associated with economic purchases if the energy charges are less than the Company's total avoided variable costs during the purchase period.

or

(iii) The total expense associated with purchased power of less than twelve months duration if the total cost of the purchase is less than the Company's total avoided variable costs and if the purpose of the purchase was solely to displace higher cost generation. Purchases made to solely displace higher cost generation exclude reliability purchases. A purchase shall be deemed for reliability where the Company's system reserve criterion is not met. Such criterion is as follows:

Operating Reserve (consisting of largest generating unit plus regulating margin plus load forecast margin)

Minus

75% of Emergency Contract Capacity

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

Equals

Spinning Reserve Requirement

(iv) Energy receipts that do not involve money payments such as Diversity Energy and pay-back of Storage Energy are not defined as Purchased or Interchanged Power relative to the Fuel Clause.

Minus

(c) The cost of fossil and nuclear fuel recovered through inter-system sales including the fuel costs related to economy energy sales and other energy sold on an economic dispatch basis.

Energy deliveries that do not involve billing transactions such as Diversity Energy and pay-back of Storage Energy are not defined as sales relative to the Fuel Clause.

IV. DISCOUNTS

Discounts will apply only to charges under Paragraphs III.A. and C. for services with delivery voltages of 69 kV or higher.

A.	KW Demand Discount All kW of Demand	@ $0.66 per kW Discount
B.	Energy Charge Discount Energy Charge	@ 2.0% Discount

V. MINIMUM CHARGE

The minimum charge shall be such as may be contracted for but not less than the sum of the charges in the 30-Day Rate Paragraph III.A. and B. including applicable discounts in Paragraph IV.A. This includes no allowances of energy, and all energy used shall be paid for in addition

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

V. MINIMUM CHARGE (continued)

at the above rates. Such minimum charge shall be increased in the amount of the applicable fuel adjustment under Paragraph III.D.

VI. OTHER PROVISIONS

A. Determination of kW Demand

The kW of demand billed under Paragraph III.A. shall be the highest of:

1. The highest average kW measured at this location in any 30-minute interval during the on-peak hours of 7:00 a.m. to 10:00 p.m. Mondays through Fridays, plus 30% of the excess of this amount determined in a similar manner during any other period during the current billing month, or

2. 90% of the highest kW of demand at this location as determined by Subparagraph VI.A.1., above during the billing months of June through September of the preceding eleven billing months, or

3. 50% of the kW of demand contracted for under Paragraph VII., or

4. 1500 kW.

B. Determination of rkVA Demand

The rkVA of demand billed shall be the highest average rkVA measured in any 30-minute interval during the current billing month.

C. Meter Reading and Billing

When the actual number of days between meter readings is more or less than 30 days, the kW Demand Charge, the rkVA Demand Charge, the charge per kW of contracted demand in Paragraph VIII.C., and the minimum charge of the 30-day rate will each be multiplied by the actual number of days in the billing period and divided by 30.

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

VI. OTHER PROVISIONS (continued)

D. Late Payment Charge

A late payment charge of one percent (1%) per month will be applied on all amounts that remain unpaid on the Company's books on the next billing date.

VII. DETERMINATION OF CONTRACT DEMAND

The contract demand under this schedule shall be the maximum number of kW which the Company is to supply. Contract demands may be changed by mutual agreement as to amount of change and term of agreement.

VIII. BREAKDOWN, RELAY OR PARALLEL OPERATION SERVICE

Breakdown, relay or parallel operation service may be contracted for under this schedule under the following conditions:

A. Suitable relays and protective apparatus shall be furnished, installed, and maintained at the Customer's expense in accordance with specifications furnished by the Company. The relays and protective equipment shall be subject, at all reasonable times, to inspection by the Company's authorized representative.

B. The contract demand to be billed under this Paragraph VIII. shall be the maximum number of kW which the Company is to supply. Contract demands may be changed by mutual agreement as to the amount of change and term of agreement. In case the maximum measured kW demand exceeds the contract demand, the measured demand becomes the contract demand for that month and for the next succeeding eleven months.

C. When breakdown, relay or parallel operation service is furnished, the 30-Day Minimum Charge for electricity supplied under this schedule shall be not less than $10.78 per kW of demand contracted for under Paragraph VIII.B. plus any positive fuel adjustment charge under Paragraph III.D.

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

IX. SCHEDULE TERMINATION, MODIFICATION OR REVISION

Whenever the Federal Energy Regulatory Commission shall permit a change in the rates set forth in the Company's Schedule RS - Resale Service to Municipalities and Private Utilities - to take effect, this rate schedule shall on the same effective date be modified so as to produce from the Federal Government customers served hereunder the same rate of return as the rates thus permitted to become effective for Schedule RS customers, utilizing for that determination the same ratemaking methodology and test period as used in determining the RS rates. Pending final decision by the FERC, the Federal Government would pay a rate as initially proposed by the Company after the suspension period, if any, subject to refund after final decision of any excess payments plus interest at the rate as authorized by the FERC. This method of determining a rate for the Federal Government customers will continue in effect indefinitely; provided, however, that either party may terminate this method of rate determination by giving six months' notice. Should such a termination occur, the parties, if appropriate, would negotiate a new rate in good faith.

X. TERM OF CONTRACT

The term of contract for the purchase of electricity under this schedule shall be such as may be mutually agreed upon, but for not less than one year.

SCHEDULE MSSG
FEDERAL GOVERNMENT INSTALLATIONS
(STANDBY GENERATOR - EXPERIMENTAL)

I. APPLICABILITY

This schedule is applicable on a voluntary, experimental basis to any Federal Government installation that: (1) contracts for 1500 kW or more of alternating current electricity under Schedule MS - Federal Government Installations or Virginia jurisdictional Schedule 6 - Large General Service and (2) has standby generation capacity of 150 kW or greater. Under this schedule the Customer agrees to transfer load normally served by the Company to his standby generation upon Company request. Standby generation is defined as generation installed by the Customer to supply electricity primarily during those times when service is not available from the Company. The Customer may operate generation in parallel with the Company provided that any operation, outside of requested operation, is limited to no more than 10 percent of the hours in any billing month of the year.

II. STANDBY GENERATOR OPERATION

A. The Company may request operation of the Customer's standby generator only from December 1 through March 31 (Winter) during the hours between 6 a.m. and 12 noon, weekdays, or from June 1 through September 30 (Summer) during the hours between 2 p.m. and 8 p.m., weekdays.

B. Company requested operation of the Customer's standby generator will be limited to a maximum of 200 hours per year, 125 hours per season, and once per day.

III. NOTIFICATION

A. The Company will provide no less than 4 hours notice of requested operation of the Customer's standby generator.

B. A notification procedure shall be established which is mutually agreeable to the Customer and the Company. In the event that the Customer is unable to receive notification, due solely to circumstances attributable to the Customer, notification shall be deemed received by the Customer.

(Continued)

SCHEDULE MSSG
FEDERAL GOVERNMENT INSTALLATIONS
(STANDBY GENERATOR - EXPERIMENTAL)
(Continued)

V. BILLING TO THE CUSTOMER

Company owned facilities will be required for this experimental program to meter the output of the Customer's generator and will be provided at no cost to the Customer. The estimated new installed cost of such facilities will be calculated for informational purposes. During the experimental period, the Customer shall not be billed for any costs incurred by the Company due to meter reading, processing or communication. For installations with generator capacity between 150 kW and 249 kW, the Customer will be required to provide for all necessary installation costs associated with the installation of the meter on the generator. For installations with generator capacity of 250 kW or greater and during the first year of this program, the Company will reimburse the Customer for 100 percent of reasonable installation costs associated with the meter installation. After the first year of the program, all new customers requesting service under Schedule MSSG will be responsible for meter installation costs.

VI. METERING AND FACILITY INSPECTION

All facilities necessary to meter the Customer's standby generation shall be installed and maintained according to Company specifications. All electrical facilities on the line side of the metering installation shall be subject to inspection by the Company's authorized representative at all reasonable times.

VII. METER READING AND PAYMENT

Meters may be read monthly. Payments under this schedule will be used to reduce the concurrent Schedule MS or Schedule 6 bill of the Customer.

VIII. TERM OF CONTRACT

The term of contract under this schedule shall be such as may be mutually agreed upon, but for not less than one year.

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EAC STANDARD FORM
July 1985

page 1 of 2

TELEPHONE CONVERSATION SUMMARY

Project: Fort Belvoir Energy Study

Contract No. _____ EAC Project No. _____

From Joe Barcia Telephone _____ Date 4/6/91 11:00

To Mike Smith Time 4/11/91 2:00
~~4/11/91 3:00~~
4/11/91 3:30

Discussion Fuel Costs

1) Gas:
Use: 53.29¢ / therm
This cost is average cost based on payments to the Gas Co. plus meter reading expense, visual inspection, walking the line & minor maintenance

2) Steam:
Use: $9.97 / 1000 lbs of steam
This is based on last year's average cost of steam including oil price and maintenance (Not based on current price of oil)

3) Oil
Use: $0.99/gal for No. 5 & 6 oil
$1.03/gal for No 2 oil
These are current price. Anticipation that oil price will drop in October

4) Gas Metering:
Master metering for entire base, but several locations have submeters. Billing from the

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TELEPHONE CONVERSATION SUMMARY

Project: Fort Belvoir

Contract No. _____ EAC Project No. _____

From Mike Smith Telephone _____ Date 4/11/91

To Jose Time 3:30 pm

Discussion Fuel Costs (Cont)

Gas Company is achieved by subtracting the gas in those areas that don't have interruptible rate from the total. The housing areas do not have separate metering.

51 Maintenance of Oil & Gas Distribution
Will try to provide data concerning maintenance costs for oil & gas distribution facilities. Will call back on Tuesday.

Fuel Rates Used in Cost Analysis

1) Cost of Gas

As per Mike Smith @ Ft. Belvoir, the cost of gas to be used : 53.29¢ / therm.

Therefore: $5.33 / MBTU for gas

2) Cost of Oil

As per Mike Smith, cost of #2 fuel oil = $1.03/gal.

Therefore: @ 138,700 Btu/gal, cost of oil:
$7.43 / MBTU

3) Cost of Electricity

As per Mike Smith: Average cost of electricity = $0.0616/Kwh

Therefore Cost of Electricity @ 3,413 Btu/Kwh =
= $18.05/MBTU

APPENDIX C
MEMORANDA AND LETTERS

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July 1985

TELEPHONE CONVERSATION SUMMARY

Project: Fort Belvoir

Contract No. _____ EAC Project No. 89034.01

From Arun Bagal (Curtis Engine & Equipment) Telephone (800)638-4923 Date 6/5/91

To Jose Barcia Time 11:30

Discussion: Budget cost for Natural Gas Generators

The following are the cost obtained from Waukesha C.

Size Desired	Equivalent Available Size	Budget Cost	Fuel Consumption
600 Kw	630 Kw	$195,000	7,373 cu ft/hr.
750 Kw	780 Kw	$276,000	8,281 cu ft/hr.
1000 Kw	1055 Kw	$445,000	12,089 cu ft/hr.
1500 Kw	1720 Kw	$605,000	19,480 cu ft/hr.

These generators are 1200 rpm generators (vs. 1800 rpm for diesel). They should have less maintenance and longer life (up to 10,000 hours)

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TELEPHONE CONVERSATION SUMMARY

Project Fort Belvoir

Contract No. _____ EAC Project No. _____

From Jose Barcia Telephone 750-5693 Date 4/30/91

To George Chastka - Washington Gas Time 11:20 am

Discussion

- Mr. Chastka mentioned that no final decision has been made on whether the Gas Co. will pay for the gas distribution lines at the four complexes at Ft. Belvoir. The reason for no final decision is that the preliminary line design engineering has not been completed. They hope to finish it by the end of this week.

- Mr. Chastka did mention that the Gas Co. does not have a problem with the Concept and that the decision for the concept is that they could do it legally and in accordance to G. policy.

- Hence, provided the cost and investment ratios are adequate, they would do it.

- If the costs are too high, Mr. Chastka mentioned that Ft. Belvoir could pick up the remainder cost above the cost that the Gas Co. would be willing to spend.

- He will get back to me at the end of the week.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REFARR Telephone 664-1232 Date 4/30/91

To MR MIKE STUMBAUGH, ENERGY OFFICER Time 3:15

Discussion ASKED MR STUMBAUGH IF, IN THE 300 AREA, THERE ARE MORE BUILDINGS WHICH REQUIRE SUMMER STEAM FOR AIR CONDITIONING REHEAT OR DOMESTIC HOT WATER HEATING OTHER THAN THE TEN BUILDING LISTED IN THE PROJECT SCOPE.

HE SAID THAT HE WAS NEW TO THE BASE AND WOULD INVESTIGATE AND CALL BACK TOMORROW.

5/1 10AM MR STUMBAUGH CALLED TO SAY HE HAD TALKED TO GARY SULLAVAN 664-5788 @ BLDG 331 AND HE SAYS THAT BLDGS THAT I MENTIONED (214, 215, 216, 218, 224, 225 & 226) HAVE DOMESTIC HOT WATER CONVERTERS THAT REQUIRE SUMMER STEAM.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-5256 Date 4/24/91

To MR MIKE SMITH Time 10 AM

Discussion FT. BELVOIR PURCHASES WATER FROM FAIRFAX CO. AT A BASE RATE OF .65/1000 GAL WITH A MOUTHLY DEMAND CHARGE. FT BELVOIR USES ABOUT 4.4 MILLON GALS/DAY AND WITH THE DEMAND CHARGE AVERAGE COST IS CURRENTLY 1.28/1000 GALS.

MR. MIKE STUMBAUGH HAS REPLACED MR KAHN AS ENERGY CHIEF AT THE POST MAY BE REACHED AT MR KAHN'S OLD NUMBER.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From MR BERGE B&W SALES CO INC PEERLESS BOILER REP Telephone 948-2723 Date 4/19/91

To RE FARR Time 10:30

Discussion PRICE QUOTES ON BOILERS, PRICES INCLUDE ALL CONTROLS, FREIGHT AND ARE TO MIL SPEC REQUIREMENTS FOR B18796 $B18897 WITH MIL SPEC PAINT. UNITS ARE ASSEMBLED & TESTED.

704 FDA SU	=	8,150.
707	=	9,130.
709	=	9,830.
710	=	10,170.
712	=	10,910.
715	=	11,350.
724	=	14,990.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From MR. MIKE SMITH Telephone 664-5256 Date 4/18/91

To RE FARR Time

Discussion MIKE WAS RETURNING CALL FROM JOSE BARCIA WITH INFO REQUESTED REGARDING MAINTENANCE COST FOR HEATING UNITS IN HOUSING AREAS

CONTRACTOR HAS A LUMP SUM CONTRACT OF $238,000. FOR MAINTENANCE OF UNITS IN QUESTION, HOWEVER THE MECHANIC RATE IS 19.97/HR AND INFO FROM CONTRACTOR INDICATES TIME REQUIRED TO SERVICE 1 UNIT IS FROM 1½ to 2 HOURS.

For Maintenance
Use $30/hr for
$40/hr ot

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 355-8074 Date 4/17/91

To MR JOHN STRANG, FT BELVOIR DEH Time 8:30

Discussion 1-60 GEN OFFICERS QTRS

- ORIGINAL BOILERS WERE COAL FIRED 1934-35
- WERE CONVERTED TO OIL AROUND 1950
- OIL FIRED CAST IRON LP STEAM BOILERS INSTALLED 1975-76
- ABOUT THREE OF THESE HAVE BEEN REPLACED TO DATE
- ALL BOILERS PROVIDE LP STEAM EXCEPT FOR BLDG Nº 1
- ORIGINAL CAST IRON RADIATORS ARE A MAINTENANCE PROBLEM

WOODLAWN VILLAGE

- AC PROVIDED BY LENNOX HEAT PUMP SYSTEMS
- TWO STORY TH UNITS ARE SERVED BY ONE SYSTEM
- STATED THE DESIRE FOR MASTER METERING

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TELEPHONE CONVERSATION SUMMARY

Project: Fort Belvoir Energy Study

Contract No. _____ EAC Project No. _____

From: Jose Barcia Telephone _____ Date: 4/6/91 11:00

To: Mike Smith Time: 4/11/91 2:00
~~4/11/91 3:00~~
4/11/91 3:30

Discussion: FUEL COSTS

1) Gas:
Use: 53.29¢ / therm
This cost is average cost based on payments to the Gas Co. plus meter reading expense, visual inspection, walking the line & minor maintenance

2) Steam:
Use: $9.97 / 1000 lbs of steam
This is based on last year's average cost of steam including oil price and maintenance (Not based on current price of oil)

3) Oil
Use: $0.99/gal for No. 5 & 6 oil
$1.03/gal for No. 2 oil
These are current price. Anticipation that oil price will drop in October

4) Gas Metering:
Master metering for entire base, but several locations have submeters. Billing from the

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TELEPHONE CONVERSATION SUMMARY

Project Fat Belvoir

Contract No. _____ EAC Project No. _____

From Mike Smith Telephone _____ Date 4/11/91

To Jose Time 3:30pm

Discussion Fuel Costs (Con't)

Gas Company is achieved by subtracting the gas in those areas that don't have interruptible rate from the total. The housing areas do not have separate metering.

51 Maintenance of Oil & Gas Distribution
Will try to provide data concerning maintenance costs for oil & gas distribution facilities. Will call back on Tuesday.

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9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

MEETING REPORT

Project: ENERGY SAVINGS OPPORTUNITY SURVEY, FORT BELVOIR, VA

Contract (Client Project) No. DACA 31-89-C-0198 EAC Project No. 89034

Place WASHINGTON GASLIGHT COMPANY, SPRINGFIELD, VA Date APRIL 10, 1991

Purpose TO DISCUSS WASHINGTON GAS LIGHT COMPANY INVOLVEMENT IN THIS PROJECT

Person(s) Present	Code/Designation	Firm/Agency	Telephone
George Chastka, Manager, Multifamily Market		Washington Gas	(703)750-5693
Bob Lloyd, Senior Accounts Manager		Washington Gas	(703)750-4511
Virender Puri, President		EAC	(703)978-0923
Jose Barcia, Engineer		EAC	(703)978-0923

ITEMS DISCUSSED ARE AS FOLLOWS:

1. Jose Barcia explained the magnitude of the project and described the four residential complexes involved.

2. Virender Puri mentioned that the economies of converting to gas may depend on the cost of installing the gas distribution lines and asked if Washington Gas Light Company would be willing to subsidize any of the gas line installation costs.

3. Mr. Chastka explained what the Gas Company had done at other projects such as Bolling and Andrews Air Force Bases and mentioned that perhaps something similar could be accomplished at Fort Belvoir.

4. Mr. Chastka mentioned that the Gas Company will consider installing the distribution gas lines at no cost to Fort Belvoir.

5. Mr. Chastka explained that the Gas Company would prefer to run its own lines into Fort Belvoir to serve these complexes, but because of the long distances involved, it would be cost effective to tap into the existing main distribution lines owned by Fort Belvoir.

6. Mr. Chastka will ask the Gas Company officials for a policy decision to see if they would be willing to tap into Fort Belvoir's lines and install the distribution lines to serve the residential complexes. Then after installation is complete, the Gas Company would turn over their lines to Fort Belvoir and Fort Belvoir's personnel would maintain the lines.

7. Each complex would be master metered and placed on a sliding block rate.

8. Mr. Bob Lloyd was provided with prints of the residential units except Woodlawn Village. EAC will provide additional information for Woodlawn Village.

9. Mr. Chastka indicated that the Gas Company's engineering group would perform a preliminary design and that he should have some answers in about two weeks.

Prepared by Jose Barcia

cc: CC, PM

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TELEPHONE CONVERSATION SUMMARY

Project Ft. Beloir - Substation 505A

Contract No. _____ EAC Project No. 89034.01

From Jose Telephone _____ Date 2/19/91

To Drew Time 3.00

Discussion COST OF GENERATOR

Cost for a 750 Kw generator @ 4160 volts

$100,000 basic cost plus $12,000 - 15,000 additional because of the voltage.

The transfer switch required; we want a close transition so that there is no flicker when the generator comes on the line. He will check on a cost and let me know.

→ Cost of a 1200 A 4160 volt closed transition transfer switch is $76,000.

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TELEPHONE CONVERSATION SUMMARY

Project Fort Belvoir – Lowell Village

Contract No. _____ EAC Project No. _____

From Bob Holke Telephone 412-487-8717 Date 9/30/91

To Joe Barcia Time 3:40

Discussion Gordon-Piatt Burner Rep. w/ Accu-Temp Co.

Cost of burner for gas in existing boiler (S4.1G) burner: $795

Cost of boiler (gas) in lower size (198 MBH) would range from $1500 to $1800.

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TELEPHONE CONVERSATION SUMMARY

Project Fort Belvoir – Rossell Village

Contract No. _____ EAC Project No. _____

From Jose Barcia Telephone 215-329-5545 Date 8/30/91

To Tobin Rank (& Ken) w/ Weil-McLain Co. Time 10:30 am.

Discussion Cost of replacing burners & boilers for Rossell Village

– Replace burner
Need to change burner and a new front plate
Can downsize burner about 30% if size of boiler is too large.
Rough cost (retail) for the burners is $1400 (this would be discounted to the contractor) & maybe a 20% reduction, depends on several factors.
Cost for the front plate is $190.

– Replace boiler. If a lower size boiler can be used, could use a PFG 5 PI boiler which has a net output of 177 MBH. Overall efficiency of 80%
Cost of this boiler would be about $1600.

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TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir / DeWitt

Contract No. _____ EAC Project No. _____

From Joe Barci Telephone 359-3055 Date 2/13/91

To Ed Covell - VA Power Time 11:30

Discussion Stand-By Generation Rate.

Rate MSSG - Applicable to Large Federal Customers

Customers such as CBA take advantage of this rate.

Key portions of rate:

- The demand generated is calculated as average capacity generated. Therefore it is possible to be below the contracted demand during a billing period if the generation on a previous occasion during the same period had exceeded the contract demand.
  Ex: during June called twice and generate 300 Kw and 350 Kw. The average capacity generated for purposes of payment would be 325 Kw
- If the demand generated during different billing periods is less than the contracted amount, they pay for the lesser amount and if payment has been made previously on a higher amount, then it is deducted. Example: called in June and generate 350 Kw called in July and generate 300 Kw. Since they paid 350 Kw in June for July they paid for 300 Kw and deduct the 50 Kw payment.

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TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir / DeWitt

Contract No. _____ EAC Project No. _____

From Joe Bucci Telephone _____ Date _____

To Ed Correll Time _____

Discussion Con't - Stand by generation rate

- Usually VA. Power notifies by 5 p.m. of the previous day in the winter and in the morning (before noon) of the same day in the summer. No less than 4 hours notice

3) At Fort Belvoir VA. Power would pay for the metering cost for the generator

4) No problem having generators at DeWitt and at Substation 505-A. Would require two sets of meters that would be on magnetic tapes and would be coordinated during meter reading.

5) If the generators run isolated from VA. Power and not on parallel, there is no need for interconnection relays and protective equipment.

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TELEPHONE CONVERSATION SUMMARY

Project Fort Belvoir

Contract No. _____ EAC Project No. 89034.01

From Jose Barcia Telephone 359-3055 Date 2/4/91

To Ed Covell - VA. Power Time 11:00

Discussion Fort Belvoir Electric Billing Dept.

1) Average fuel charge for MS rate
(Since April 1990) : - ¢.00093
(Before " ") : - ¢.00190

Therefore, the average cost / Kwh =
2.165 ¢/Kwh - .093 ¢/Kwh (fuel) = 2.072 ¢

2) Peak Demand in 1990:
28,735 Kw (July use June 29 - Aug. 1)

3) Corresponding Kwh (July 1990)
4,868,000 Kwh

4) Min. Demand for 1991
25,861

5) Woodlawn Village - served on main Ft. Belvoir meter since June 1990.
Peak Demand Summer (August use): 2102 Kw
Winter (January) : 4274 Kw

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TELEPHONE CONVERSATION SUMMARY

Project Fort Belvoir

Contract No. _____ EAC Project No. _____

From Jose Barcia Telephone 548-2045 Date 1/3/91

To Wayne Meason Time 3:18 pm.

Discussion 1) Rogue Creek Village

A) Oil Warm Air Furnace – Carrier
Model 58 HU 055 upflow furnace
Input: 69,350 Btuh, Output: 55,000, Efficiency 79%
Cost: $650

B) Gas Warm Air Furnace – Carrier
Model 58 SSC 055 – Induced combustion
Input: 63,500 Btuh, Output 53,000 Btuh, Efficiency 83.5%
Cost: $540

2) Rossell Village
Carrier Gas Boiler –
Model 61 AWB – 299100, Spark ignition
Max Input: 299,000 Btuh
Heating Capacity: 232,000 Btuh
Efficiency: 77.6%
Cost: $1,160.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-5256 Date 1/3/91

To MR MIKE SMITH ABOUT COST TO GENERATE STM @ BLDG 332 1442 Time

Discussion 12/31 1:00 NOT IN

1/2 10:00 BUSY SIGNAL, 10:15 ", 10:20 ", 10:30 "; 10:50 LEFT MESS to CALL

1/3 11:15 MIKE CALLED & SAID THAT THE STEAM COST WHICH FT BELVOIR CHARGES CLIENTS WHO USE STEAM IS BASED ON COMBINED OPERATION & MAINTAINENCE FIGURES FOR ALL BASE CENTRAL HEATING PLANTS. AT THIS WRITING FT. BELVOIR IS CURRENTLY CHARGING $9.97 / 1000 lbs OF STEAM.

TELEPHONE CONVERSATION SUMMARY

Project: ESOS Survey, Fort McNair, Belvoir, Dewitt Army Hospital

Contract No.: DACA 31-89-C-0198 EAC Project No.: 89034.01

From: Jose Barcia Telephone: (703) 978-0923 Date: 01/03/91

To: Mr. Mike Smith Telephone: _____ Time: _____

Discussion:

1. The metering data obtained is Kwh only, no demand.
2. He can provide information on Building 505-A and metering data for the previous 3 years (3 years may be required because of past problems with metering).
3. The electric rate they are currently using is $0.0616/Kwh.
4. I will pick up the data on Monday, January 7 when I am at Fort Belvoir. He is at Room 113, Building 1442.

Prepared by: Jose Barcia

JB/rc

cc: cc, PM(Jose)

\b\89034\letters\010391.tc1

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~~TELEPHONE~~ CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone _____ Date 12/19

To MIKE KATZ Time 11:00

Discussion PJ, KL, & REF MET MIKE AT #1359 TO SURVEY BLDG.

I ASKED MIKE TO RETURN BLDG DWGS ON 307, 327 & 357
I ALSO ASKED FOR OTHER REPORTS ON LP STEAM BOILER BLDGS,
HE PROVIDED A WORDPERFECT 4.2 DISK W/ 317 (RECEIVED PREV.),
309 & 357 WHICH LEAVES 7 TO GO WHICH HE SAID HE WAS
FINISHING UP AND WOULD BE BY EAC ON THUR OR FRI WITH
THESE AVE #1359 ECO LIST.

12/20 10:00 I CALLED AND LEFT MESS. FOR HIM TO CALL

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-2268 2991 Date 12/13

To SGT. BRAGG Time 3:00

Discussion – SET UP FIELD SURVEY OF # 1359 CONTROL TOWER FOR 9:00 AM WED 12/19/90 FOR MIKE KATZ & PJ, KEVIN & MYSELF WILL MEET MIKE AT 11:AM TO DISCUSS HIS FINDING AND THEN LOOK AT & MEASURE BUILDING OURSELVES.

– I WILL CONFIRM WITH SGT BRAGG TOMORROW

12/14 9:15 CALLED SGT BRAGG TO CONFIRM – NOT IN – HE WILL CALL BACK

9:38 CALLED BACK to CONFIRM 12/19 9:00 APPOINTMENT

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-6251 Date 12/11/90

To KAREN CHAMBERS (PLANS) BLDG 1442 Time 10:30

Discussion

ASKED IF SHE HAD ANY RECORDS OF BLDG 1359, CONTROL TOWER. SHE CHECKED & SAID SHE DID. I MADE AN APPOINTMENT TO LOOK AT FILES @ 7:00 TOMORROW 12/12/90.

12/12 VISITED KAREN CHAMBERS IN BLDG. 1442 AND DRAWINGS OF CONTROL TOWER WERE REPRODUCED FOR OUR USE. LIMITED INFO AVAILABLE. ONLY GEN RM ADDITION, HVAC REHAB & AIRPORT LIGHTING NO ORIG. ARCH DWGS!

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664.4041 Date

To COL PITTMAN Time

Discussion 12/11 9:15 LEFT MESS TO CALL EAC ABOUT ACCESS TO CONTROL TOWER #1359

4:00 COL PITTMAN'S OFFICE CALLED BACK AND TOLD ME TO CALL MSGT BRAGG AT 664-2268 or 2991 FOR APPOINTMENT TO INSPECT BLDG. THEY SAID THEY WOULD CALL MSGT BRAGG & TELL HIM THAT WE WOULD BE CALLING.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-1232 Date 12/10/90

To MR SCOTT BELFIT (OUT TILL 12/17) MR PATRICK MCLANCKLIN Time 2:00

Discussion ASK SEVERAL QUESTIONS:

1- ASKED WHO TO CONTACT TO GAIN ACCESS TO BLDG 1359, CONTROL TOWER TO DO FIELD INVESTIGATION FOR POSSIBLE E.C.O.'S & COMPUTER MODELING.
A: TALK TO COL. PITTMAN WHO IS IN CHARGE OF DAVIDSON AIR BASE AT 664-4041

2- ASKED TO BORROW A COPY OF THE 1987 STUDY OF BLDG 1422 CENTRAL STEAM PLANT AND WAS REFERRED TO MR BOB FLANAGAN IN 1442 AT 664-6251

3- ASKED TO HAVE APPOINTMENTS ARRANGED TO FIELD INSPECT 1-99 AREA HOUSING QUARTERS. I SAID WE WOULD LIKE TO INSPECT ONE OF EACH TYPE OF HOUSING WHICH WOULD BE THE GENERALS QUARTERS, A 2 STORY GABLE TYPE, A SINGLE STORY AND A TWO STORY UNIT.
A: ASKED ME TO CALL THE CHIEF OF FAMILY HOUSING AND SPEAK TO MS. NANCY VAN CAMTENHOUT OR MS. DONNA NEESE AT 664-1163 FOR AN APPOINTMENT TO BE ARRANGED.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-6251 Date 12/10/90

To MR BOB FLANAGAN BLDG 1442 Time 2:00

Discussion

ASKED ABOUT THE 1987 STUDY REFERENCING STEAM SERVICE FROM MAIN BOILER PLANT. MR FLANAGAN SAID HE COULD NOT RECALL SUCH A STUDY.

ASKED IF FLOYD HANDY MAY POSSIBLY HAVE THAT INFO., HE SAID CONTACTING MR HANDY WAS WORTH A TRY.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From CEF Telephone 664-1911 Date 12/10/90

To MR FLOYD HANDY BLDG 1442 Time 3:00

Discussion

ASKED ABOUT THE 1987 STUDY REFERENCING STEAM ~~SERVICE~~ FROM MAIN BOILER PLANT. MR HANDY SAID HE REMEMBERED SEEING IT BUT DIDN'T KNOW WHERE IT WAS AT PRESENT. HE SAID HE WOULD TRY TO FIND A COPY AND CALL BACK IF HE HAD ANY LUCK.

12/11 2:15 MR. HANDY CALLED TO SAY HE HAD FOUND SOME INFO. ON THE SUBJECT. I WILL SEE HIM TOMORROW MORNING 12/12

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From MIKE KATZ Telephone 620-9692 Date 11/14/90

To _____ Time _____

Discussion 11/14/90 3:20 NOT IN - LEFT MESS. TO CALL

FRI 11/16/ 2:00 MIKE SAID HE WAS WORKING ON REPORT FOR 1ST 4 BLDGS & WOULD BE AT EAC ON MON

MON 11/19 1:45 MIKE CALLED TO SAY HE WAS STILL WORKING ON 1ST 4 BLDGS & WOULD NOT BE IN MON BUT SHOULD BE FINISHED THE A SOON.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From MIKE KATZ Telephone 620-9692 Date 11/7/90 WED

To REF Time 8:30

Discussion

MIKE SAID THAT MR MILLER WAS BEING COOPERATIVE, PROVIDING ESCORTS, ETC. HE HAS GONE THRU BLDGS 309, 357 & 50% OF 307 AT THIS WRITING. HE EXPECTS TO BE DONE WITH 307 & 317 BY AM. OF THUR. 11/8 AND HAS SCHEDULED MEETING W/ MR. MILLER IN SAME AFTERNOON. HE WILL THEN START MR CROSS's SIX BUILDINGS.

HE EXPECTS TO HAVE REPORT ON FIRST FOUR BUILDINGS DONE THE FIRST OF NEXT WEEK (11/12-13) AND THE REMAINING SIX BY THE FOLLOWING WEEK (11/19-20).

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-6062 Date 11/

To MR BEN HANKINS BLDG 1080 10th & GUNSTON Time

Discussion 11/5 2:00 NOT IN BUILDING - BACK LATER
11/5 3:30

MR HANKINS SAID THAT HE HADN'T FORGOTTEN ABOUT US AND THAT THE BLDG 363 PLANS ARE NOT BACK FROM THE PERSON WHO IS REVIEWING THEM. HE HOPES TO HAVE THEM BACK THIS WEEK AND WILL CALL ME AS SOON AS THEY ARE RETURNED.

DAVID WORTHINGTON

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From MR BEN HANKINS Telephone 664-6062 Date 11/8/90

To REF Time 11 AM

Discussion

CALLED TO SAY THAT THE BLDG 363 DWGS WERE BACK IN HIS POSESSION. I MADE ARRANGEMENTS TO BORROW SAME OVER THE WEEKEND OF 11/10&11. AND WILL RETURN THEM 11/12 AM.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From MR SCOTT BELFIT Telephone 664-1232 Date 10/31/90

To REF Time 10:00

Discussion

MR BELFIT SAID HE TALKED WITH MR MILLER WHO WAS COOPERATIVE AND WOULD ARRANGE FOR AN ENLISTED MAN TO ESCORT MIKE KATZ IN BLDGS 307, 309, 357 & 317 AND MIKE SHOULD WRITE DOWN ANY TECHNICAL QUESTIONS AND CALL MR MILLER TO MAKE AN APPOINTMENT TO TALK ABOUT SAME.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-1232 Date 10/30/90

To MR PATRICK McLANCKLIN Time

Discussion 10/30 9:50 NOT IN

10/30 11:00 NOT AT DESK ASKED TO HAVE HIM RETURN CALL

10/31 9:00 SCOTT BELFIT RETURNED CALL

MR. BELFIT SAID HE HAD RELATED OUR CONVERSATION OF 10/29 TO MR. McLANCKLIN AND HE STATED THAT IT WAS DEFINITELY MR MILLERS RESPONSIBILTY TO PROVIDE ASSISTANCE & ESCORT FOR BUILDINGS 307, 309, 317 & 357. HE SAID HE WOULD SPEAK TO MR MILLER AND LET US KNOW WHAT HAPPENS.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

REF: ACCESS to 334

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-5788 Date 10/30/90-

To MR. HARRY CROSS Time

Discussion 10/30 11:37 - NO IN WILL BE BACK 10/31

10/31 11:15 - OUT TO LUNCH BACK AT 12:30

10/31 12:30 - NOT IN LEFT MESS. TO CALL EAC

10/31 2:05 - IN

ASKED IF IT WOULD BE OK TO GO TO BLDG 334 AT 7:00 AM 11/1 WITH MIKE KATZ AND THEN ON TO 362, 363, 365, 327 & 331 FOR ENERGY STUDY. HE SAID HE HAD NO PROBLEM WITH THAT.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-5925 Date 10/29/90

To MISS LLOYD (NOT IN) Time 3:20

Discussion SPOKE TO MR. GREEN AND EXPLAINED WHO EAC WAS THAT WE HAD A CONTRACT TO DO AN ENERGY STUDY AT FT. BELVOIR FOR THE BALT. CORPS. ETC. AND WANTED TO KNOW IF THEY PROVIDED ESCORTS FOR CONTRACTORS.

HE REFERRED ME TO A MR. JERRY SULLIVAN (664-5773 OR 664-4038) AND SAID MR SULLIVAN WOULD MAKE ARRANGEMENTS WITH MILITARY POLICE FOR EAC TO ENTER R&D AREA.

THE QUESTION AS TO IF THE MILITARY POLICE PROVIDE ESCORTS WAS NOT ANSWERED.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-1232 Date 10/29/90

To MR PATRICK McLANCKLIN (NOT IN) Time 3:15

Discussion SPOKE TO MR SCOTT BELFIT AND TOLD HIM THAT MR MILLER, WHO WAS ON OUR CONTACT LIST FOR THE BUILDINGS IN QUESTION (307, 309, 317 & 357), WAS TO BUSY TO PROVIDE ESCORT AND ASKED IF MR McLANCKLIN COULD PROVIDE EAC WITH AN ESCORT FOR MIKE KATZ.

HE SAID HE WOULD TALK TO MR McLANCKLIN AND HAVE HIM CALL US. IN THE MEAN TIME HE ASKED ME TO CALL MRS LLOYD AT MILITARY POLICE TO SEE IF THEY WOULD PROVIDE EAC WITH ESCORT.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY
ECO WALK-THRU OF 307, 309, 317, 357

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-2566 Date 10/23/90 - 10/29/90

To MR. LEE MILLER BLDG. 305 Time

Discussion TUE 10/23 CALLED & LEFT MESS

TH 10/25 12:00 " " " MR MILLER CALLED AT 4:30 BUT I WAS OUT

FR 10/26 8:15 " " "

MO 10/29 1:00 " " "

3:00 MR MILLER CALLED BACK

CALLED MR. MILLER ABOUT SCHEDULE FOR MIKE KATZ TO LOOK AT BLDGS. 307, 309, 317 & 357. MR. MILLER SAID HE COULD NOT SPEND THE TIME TO ESCORT MIKE FOR THE ESTIMATED TWO DAYS IT WOULD TAKE TO GO THRU THE BUILDINGS. HE SUGGESTED THAT WE CONTACT OUR POINT OF CONTACT FOR FT BELVOIR AND HAVE THEM ARRANGE FOR ESCORT.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

REF: 363

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-6062 Date 10/22/90

To MR BEN HANKINS BLDG 1080 Time 12:45

Discussion
10:00 NOT IN - NO ANSWER
10:45 NOT IN - BACK AT 12
12:45 IN

WHEN ASKED TO MAKE APPOINTMENT TO LOOK AT #363 CONSTRUCTION DWGS. OR BORROW SAME, WAS TOLD HE DIDN'T CURRENTLY HAVE THEM. EXPECTED THEM TO BE RETURNED LAST OF WEEK. I SAID I WOULD CALL AGAIN FIRST THING FRIDAY 10/26/90.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-5256 Date 10/22/90

To MR. MIKE SMITH (RECONFIRM FUEL RATES) Time

Discussion 10/22 10 AM - NOT IN TODAY

10/23 10:10 AM - NOT EXPECTED BACK TILL MON 10/29

10/30 9:30 - NOT AT HIS DESK

10/31 10:00 - IN

MR. SMITH SAID THAT THE FUEL RATES HAD CHANGED SINCE WE LAST TALKED.

NATURAL GAS HAS REMAINED UNCHANGED

OIL Nº 2 IS NOW 1.03/GAL

Nº 5 & 6 IS NOW .99/GAL

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

REF: 363

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-6062 Date 10/26/90

To MR. BEN HANKINS BLDG 1080 10th & GOUSTON Time

Discussion 8:00 HE WAS NOT IN

10:30 ASKED IF BLDG 363 CONSTRUCTION DWGS HAD BEEN RETURNED HE SAID THEY HAD NOT.
WHEN ASKED WHEN THEY WERE EXPECTED HE SAID HE DID NOT KNOW.
I LEFT MY NAME AND NUMBER & HE SAID HE WOULD CALL AS SOON AS HIS DWGS WERE RETURNED.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

REF: BLDG 363

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-6062 Date 10/5/90 - 10/9/90

To MR. BEN HANKINS BLDG 1080 10th & GUNSTON Time

Discussion 10/5 10:00 NOT IN

10/9 9:00 IN MTG. LEFT MESS TO CALL EAC

3:30 RETURNED CALL

BLDG. 363's HVAC RENOVATION IS ALMOST COMPLETE. THE SYSTEM IS A HW REHEAT TYPE WITH THE DOM H.W. REMAINING AS IS. A NEW PENTHOUSE MECHANICAL SPACE ~~WAS BEEN~~ ADDED ON THE ROOF.

I SAID THAT I WOULD NEED TO USE THE CONSTRUCTION CHECK SET TO TAKE OFF INFO FOR COMPUTER INPUT. I SAID I WOULD BE BACK IN TOUCH LATER AFTER I COMPLETE THE CURRENT BLDG.

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY STUDY

Contract No. _____ EAC Project No. 89034.01

From REF Telephone 664-5256 Date 9/19/90

To MR. MIKE SMITH BLDG. Time 9 AM

Discussion FUEL COSTS

NATURAL GAS — INTERRUPTABLE SERVICE .526 / THERM
SCH 2 COMM & INDUST
REGULAR SERVICE UP TO 125T = .6439 / THERM
UP TO 875T = .5871 / THERM
ABOVE 875T = .5345 / THERM

OIL — Nº 2 — CURRENT .56 / GAL .99
FY91 EST ↑20% .68 / GAL 1.03

Nº 5 & 6 — FY91 .64 / GAL

ELECTRIC — CURRENT .0542 / KWH
FY91 EST .06 / KWH

BELVOIR CURRENTLY USES 28,000 KW

12316 Lee-Jackson Memorial Highway
Fairfax, Virginia 22033

VIRGINIA POWER

September 12, 1990

Mr. Jose F. Barcia
Engineering Applications Consultants
9004-B Crownwood Court
Burke, Virginia 22015-0923

RECEIVED
SEP 14 1990
EAC

Re: **ROUTE ONE SUBSTATION**
FORT BELVOIR, VIRGINIA
99-45-01-051

Dear Jose,

Attached are the demand tape printouts for the referenced account for the summer of 1989.

Please call me at 359-3055 if you have any questions.

Cordially,

Edward D. Cowell, Jr.
Marketing Services Administrator

Attachments

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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir

Contract No. _____ EAC Project No. 89034.01

From Jose Barcia Telephone 355-8074 Date 9/11/90

To John Strang Time 11:40

Discussion Energy Study – Housing Units

1) Dogue Creek Village

A) Furnaces (oil) and water heaters (electric) are supposed to be replaced. Tentative schedule is for replacement in FY 92.

B) Oil tanks were replaced approximately 8 years ago. (They are fiberglass lined – single lined not double)

2) Rossell Village

A) Boilers replaced approximately in 1984, water heaters were also replaced at the same time

B) Oil tanks were replaced in 1986.

3) Belvoir Village (Officers Quarters)

A) Boilers and water heaters need replacement

B) Oil tanks also need replacement

Concerning insulation at these housing units:

1) Dogue Creek and Rossell Village – they have installed insulation in attic spaces – blown in insulation – tried to get to R-30 level.

2) Belvoir Village – no insulation in attic because they have unusable attics.

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Burke, Virginia 22015-1630
(703) 978-0923

MEETING REPORT NO. 2

Project ESOS Survey, Fort Belvoir, Virginia

Contract No. DACA 31-89-C-0198 EAC Project No. 89034.01

Place Virginia Power Company Date: August 24, 1990

Purpose Load Profiles, Thermal Storage

Persons Present	Code/Designation	Firm/Agency	Telephone
Mr. Gary Hicks	Commercial Engineer	Virginia Power	(703) 359-3059
Ed Cowell	Marketing Services	Virginia Power	(703) 359-3055
Jose Barcia	Engineer	EAC	(703) 978-0923

1. Mr. Ed Cowell started by explaining to Mr. Hicks some of the statements made in the morning meeting with Jose Barcia.

2. Mr. Barcia asked about the possibility of Mr. Hicks providing a load profile analysis for Fort Belvoir. There was some discussion pertinent to the items that would be included in such a profile analysis.

3. Mr. Cowell stated that the account that had the 30 minute demand readings was no longer active (due to the change in accounts when the new substation was energized). Mr. Hicks would have to check to see if the data was available from the computer. If not in the computer, Mr. Hicks stated that he still could do the load profile analysis, but he would have to manually retrieve the data; therefore, it would take longer to do it.

4. Mr. Barcia requested a load profile for each of the summer months as well as the peak month. Mr. Hicks agreed that he could provide it.

5. Mr. Hicks stated that if we provide him with a computer diskette, he could provide the load data using a Lotus 1-2-3 spreadsheet. Mr. Barcia will provide Mr. Hicks with a diskette.

6. In reference to thermal storage, Mr. Hicks stated that he had access to the COOLAID computer program. He stated that Virginia Power does not normally run this program for customers or consultants. However, he would try to see if he could use the COOLAID program in conjunction with EAC to run thermal storage calculations for Fort Belvoir.

The meeting was adjourned at approximately 2:00 p.m.

Submitted by: Jose Barcia

JB/rc

cc: cc, PM

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MEETING REPORT NO. 1

Project ESOS Survey, Fort Belvoir, Virginia

Contract No. DACA 31-89-C-0198 EAC Project No. 89034.01

Place Virginia Power Company Date: August 24, 1990

Purpose Rate Schedules - Generator & Thermal Storage, Billing Information

Persons Present	Code/Designation	Firm/Agency	Telephone
Ed Cowell	Marketing Services	Virginia Power	(703) 359-3055
Jose Barcia	Engineer	EAC	(703) 978-0923

1. Mr. Barcia explained the purpose of the meeting was to collect appropriate information concerning Fort Belvoir in order to conduct an energy conservation survey.

2. Mr. Cowell explained that after the May 1990 billing, Fort Belvoir is served under a 34.5 kW distribution system from a new substation. Mr. Cowell indicated that the magnetic tape metering has not yet been installed. Therefore, the demand print-outs for this summer are not available. However, he will be able to provide us with the demand totals, but not the 30 minute demand readings for this summer. We will have to use last summer's data.

3. Mr. Cowell presented various rate schedules which may merit further study. Some of these rates are experimental and must be specifically requested by the customer, others are not yet applicable to Federal customers, but they may be in the near future.

4. Currently, Fort Belvoir is served under rate schedule MS - Federal Government Installations. An optional rate for Fort Belvoir is rate Schedule 6 - Large General Service. However, at this time, Schedule MS is better for Fort Belvoir because even though the demand charges in the Schedule MS are larger, the fuel charges are negative. According to Mr. Cowell, the negative fuel charge in Schedule MS should continue even with the present oil situation because Virginia Power's generation is only about 5% with oil.

5. Upon request, they will run a rate comparison between Schedule 6 and Schedule MS. However, Mr. Cowell indicated that he has run comparisons before and his experience is that for most large Federal customers and in particular Fort Belvoir, Schedule MS is better.

6. Schedule 6TS - Thermal Storage is not currently available to Federal Customers, but it will probably be available in the near future. However, Schedule MS can effectively be used with Thermal Storage because of Section VI.A.1. (off-peak demand only billed if it exceeds the on-peak demand, and then only by 30% of the excess).

7. Rate Schedule CS - Curtailable Service is not available to Federal customers at this time. It may eventually be extended to Federal customers in the future. However, Virginia Power has a new experimental rate Schedule 10 - Large General Service which essentially works like a curtailable service except that there are 3 (A, B, C) day classifications with different on-peak charges for each day. When Virginia Power announces that a day is classified as A (no more than 32 days/year) it is up to the customer to cut down on his use or pay the higher energy charges. Mr. Cowell indicated that this rate may be advantageous to Fort Belvoir and may merit some study. This rate is limited to 60 customers, but Mr. Cowell indicated that plenty of customers can still participate.

8. Rate Schedule MSSG - Federal Government Installations (Standby Generator - Experimental) would be applicable to Fort Belvoir if the standby generator capacity is greater than 150 kW. Mr. Cowell felt that this rate could be advantageous to Fort Belvoir. He mentioned that other large Federal customers have taken advantage of this rate. For example, the CIA contracted for 20 MW and got paid $120,000 per month.

9. Mr. Cowell mentioned that for the installation of a generator, the old substation (Hayfield Substation) had provisions (relays, protective equipment, etc.) for parallel operation. However, no provisions for parallel service have been made at the new substation (Belvoir substation).

10. Mr. Barcia indicated that for purposes of EAC's study, generators would be placed at Building 505A (Substation) and also the existing generators at DeWitt Army Hospital could be utilized.

11. Mr. Cowell indicated that under Schedule MSSG, Virginia Power could install separate metering at the site of 505-A and DeWitt to measure the load on the generators. In those cases where Virginia Power required the operation of the generator, the load would be measured at these points and a credit would be deducted from the electric bill. As long as Fort Belvoir met the agreed upon contracted demand, the credit on the bill would be issued every month. The metering equipment would be supplied by Virginia Power and would be installed by Fort Belvoir's designated contractors.

12. Mr. Cowell felt that it would not be advantageous for Woodlawn Village to switch to gas since they are taking advantage of the minimum billing demand in the winter, therefore, paying no demand charges and the energy charge under Schedule MS is only 2.165 cents per kWH.

13. Mr. Cowell suggested that we look into conversion to electric (rather than gas) from those buildings that currently have oil until all the minimum winter kW demand charges are used up.

14. Mr. Cowell provided EAC with copies of the monthly billing demands for 1989 and up to May 1990 for Fort Belvoir, Woodlawn Village, and INSCOM which until May were billed separately and now have been combined into one bill. Mr. Cowell will mail the 30 minute daily demands for last year in the near future.

15. Mr. Cowell does not perform profile analysis for customers or deal with thermal storage. He suggested a meeting with Mr. Gary Hicks for these areas. Mr. Barcia agreed to meet with Mr. Hicks after lunch.

Submitted by: Jose Barcia

JB/rc

cc: cc, PM

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Burke, Virginia 22015-1630
(703) 978-0923

August 21, 1990

Mr. Ed Cowell
Marketing Services
Virginia Electric and Power Co.
12316 Lee-Jackson Memorial Highway
Fairfax, Virginia 22033

Re: Energy Savings Opportunity Survey
Fort Belvoir, Virginia
EAC Project No. 89034.01

Dear Ed:

This is to confirm our telephone conversation of August 17, 1990. As I mentioned to you we are working on an energy project for Fort Belvoir which will require access to their electrical billing information.

This is to request a copy of Fort Belvoir's electric billing information and magnetic tape print-outs for the preceding year starting with the latest billing information. Mr. Zahir Kahn at Fort Belvoir is preparing a letter authorizing Virginia Electric and Power Company to release this information to EAC. Also, please include any similar information available for Woodlawn Village.

We would appreciate a copy of any pertinent rate schedules and any information concerning Fort Belvoir's present service, i.e., number of delivery points, metering, facilities charge, minimum contract demands, and any other information that may be useful in this study.

I appreciate your assistance in this project and look forward to working with you and other officials at Virginia Power.

Sincerely,

ENGINEERING APPLICATIONS CONSULTANTS

Jose F. Barcia
Engineer

JB/rc

cc: cc, PM

\a\89034.01\letters\082190

DEPARTMENT OF THE ARMY
US ARMY FORT BELVOIR
FORT BELVOIR, VIRGINIA 22060

REPLY TO
ATTENTION OF

ANFB-DEH-EN

21 AUG 1990

Mr. Edward D. Cowell, Jr.
Marketing Services Administrator
Virginia Power
12316 Lee-Jackson Memorial Highway
Fairfax, VA 22033

Dear Mr. Cowell:

The U.S. Army Corps of Engineers (Baltimore District) has hired Engineering Applications Consultants to perform a survey during 1990 and 1991 for energy conservation opportunities at Fort Belvoir.

Upon request, please provide the necessary information to Engineering Applications Consultants in order that their work could be completed on schedule.

Your assistance will be appreciated very much.

Sincerely,

for David L. Hale

ROGER L. CORRES
LTC, EN
Director of Engineering and Housing

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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir - ESOS

Contract No. _____ EAC Project No. 89034.01

From Jose Barcia Telephone 664-1232 Date 8/17/90

To Zahir Khan Time 11:20

Discussion

Requested to Mr. Kahn that he write a letter to Va. Power authorizing EAC access to billing/electrical information about Ft. Belvoir

Mr. Kahn indicated that he would try to have a letter by Tuesday 8/21. I mentioned that if ready by Tuesday someone could pick the letter up.

Mr. Kahn also suggested that I contact Mr. Mike Smith @ 664-5256 to see what billing information he may already have.

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July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir - ESOS

Contract No. _____ EAC Project No. 890340 01

From Jose Barria Telephone 359-3055 Date 8/17/90

To Ed Covell - VA Power Time 10:45

Discussion Requested Billing Information and Rate Schedules

According to Mr. Covell

1) VA. Power will require a letter from Ft. Belvoir prior to releasing any information in writing to us.

2) Mr. Covell mentioned that Schedule 10 for load curtailment is not available to the Federal Gov't yet but it may be available soon. However, there is a schedule (rate schedule MSSG1 that can be used for load curtailment at Fort Belvoir - payment is $72/Kw/year.

3) Recently (starting in June) Ft. Belvoir changed the electrical distribution to a new 34.5 KV loop. Under the new distribution system no provisions are available for parallel operation. Va. Power does not permit the generator and their service on at the same time. Therefore, this needs to be explored in conjunction with VA. Power's requirements.

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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir (Con't) - page 2 call to Ed Cowell

Contract No. _____ EAC Project No. _____

From _____ Telephone _____ Date _____

To _____ Time _____

Discussion

4) Mr Cowell mentioned that there are about 13 megawatts of generator capacity available throughout Ft. Belvoir. However, this capacity is only being used for emergency purposes.

5) Woodlawn Village was served separately but because of the new conversion to the new distribution system, it is now served under the one meter that serves the entire Post. The advantage to this scheme is that Fort Belvoir can use the difference between the summer peak and the winter peak without having to pay any demand charges.

6) The latest peak demand at Fort Belvoir is 25,306 kw. The winter peak is about 15,000

7) The thermal storage rate GTS is not applicable to Fed. Gov't at the present but it may be in the near future. However, because Ft. Belvoir is under schedule MS which has an on/off peak rate, they can take advantage of the MS rate in thermal storage.

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July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir

Contract No. EAC Project No. 89034.01

From Jose Barcia Telephone 664-1232 Date 4/25/90

To Mr. Kahn Time 10:15am

Discussion Called Mr. Kahn & confirm housing unit #'s as follows:

Woodlawn: (Electric to Gas): # 2600-2787* (Heat [illegible] included in [illegible])

Russell Village } # 401-432

Belvoir Village (Officer's Quarters) } oil to gas # 1-60

Dogue Creek } # 900-944

Told Mr Kahn that we will coordinate with Mr John Strong while he's on vacation.

Mr Kahn suggested that we look at the Control Tower after the housing units & mentioned that we would have to check on that.

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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft Baker EIS

Contract No. _____ EAC Project No. 89034.01

From Tex Barcia Telephone 664-2825 Date 6/25/90

To John Stang Time 10:25 a.

Discussion Left message about energy survey for housing units.

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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir Energy Survey

Contract No. _____ EAC Project No. 89034.01

From John Shang Telephone 664-2825 Date 6/25/90

To Joe Barcia Time 12:30 pm

Discussion Mr. Shang returned my call. We have scheduled a site visit for "typical" housing units on July 9, 1990 at 10:00 am.

We will meet with him in building 470, room 149 prior to the survey.

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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft Belvoir

Contract No. _____ EAC Project No. 89034.01

From Mr. Kahn Telephone 664-1232 Date 5/30/90

To Tom Borcia Time 2:00 pm

Discussion Mr Kahn called wanted to know if we can do the housing units for DeWitt. They want to be able to make decisions about gas vs. oil very soon. I told him that I would check with Mr Puri about possible schedules

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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir / DeWitt

Contract No. ______ EAC Project No. 8123[illegible]

From Jose Baeie Telephone 664-1232 Date 5/30/90

To Mr Khan Time 10:30 am

Discussion Called Mr Khan to notified him that we would focus on DeWitt Army Hospital which he was good on vacation. He informed that his vacation schedule had been changed he will leave June 26 - July 23. He suggested that we could look at the Housing units. He suggested we call Mr. John Strand - Housing Office 664-2826 or 664-4163 to coordinate looking at the housing units. Mr Khan has notified Mr Strand of the energy survey.

Conv. to UP 5/31/90
[illegible]

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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir

Contract No. _____ EAC Project No. _____

From Jose Barcia Telephone 664-1232 Date 5/18/90

To Mr Khan Time 2:30 pm

Discussion

Mr Khan will be gone between June 14 - July 6 - Notified him that survey of Hdq 305 was complete but may necessary some small items of info.

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9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

Energy Saving Opportunity Survey
Fort Belvoir, Virginia
EAC Project No. 89034.00
A/E Contract No. DACA 31-89-C-0198

May 10, 1990

Survey Status Report

March 15, 1990	Entrance Meeting
March 24, 1990	Letter to DEH requesting survey for Building 247 from 4/4/90 to 4/6/90 and Building 305 from 4/11/90 through 4/13/90.
April 2, 1990	Virender Puri called Mr. Khan for confirmation of the survey. Letter had not been received.
April 3, 1990	Letter to Mr. Khan requesting survey for Building 247 on April 18, 19 and 20 and Building 305 on April 25, 26 and 27. Letter also requested access to secured areas and any required security arrangements.
April 18, 1990	EAC staff met regarding Building 247. Mr. Salyars stated that Building 247 had the HVAC system overhauled about a year ago and that the building was scheduled for major renovations in September. Mr. Khan was not aware of these changes. Mr. Khan wanted to discuss possibly exchanging Building 247 for another building.
April 25, 1990	Meeting for Building 305 - Could not obtain security badges at Security Office. Met with Mr. Lee Miller in the morning. Mr. Miller arranged for a security escort for the afternoon.
April 26, 27, 1990	Could not proceed with survey as scheduled because escort was not available.

May 3, 1990	Returned to Building 305 and continued energy survey. Difficulty in finding security escorts. Escorts were available after 11:00.
May 7, 1990	Called to schedule with Mr. Miller.
May 8, 1990	Called to schedule. Left message on answering machine.
May 9, 1990	Called Mr. Miller. Left message on answering machine.
May 11, 1990	Got a call from Mr. Khan that escorts are available on 5/11, 5/14 and 5/15. EAC to call to confirm survey for Building 305. Survey has been set for 5/14.
May 14, 1990	Jose Barcia caled Mr. Khan. Mr. Khan indicated that the escorts are not available and EAC should make arrangements directly with Mr. Miller.

cc: cc, Jose (PM)
Mr. James Hawk

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9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

May 4, 1990

Department of the Army
Baltimore District Corps of Engineers
P. O. box 1755
Baltimore, Maryland 21201-1755

Attn: Mr. James Hawk
Project Manager

Re: ESOS Survey, Fort McNair and Fort Belvoir
A/E Contract No. DACA 31-89-C-0198
EAC Project No. 89034.00

Dear Mr. Hawk:

We would like to thank you for your acceptance of the Carrier E-20 program for use on buildings that require computer modelling, as well as for use at DeWitt Army Hospital. E-20 computer software analyzes hourly energy consumption of the building. This is a user friendly program which accomplishes all the major features of the programs outlined in the Scope of Work and is comparable to the Blast program.

We hope that you will be satisfied with the results produced by the program.

Should you have any questions or need additional information regarding this program, please call us.

Sincerely,

ENGINEERING APPLICATIONS CONSULTANTS

Virender Puri

Virender Puri, P.E.
President

VP/rc

cc: cc, PJ, Jose, PM

\b\89034\letters\050490

APPENDIX D
PROGRAMMING DOCUMENTS

INSTALL BOILERS AND WATER HEATERS

300 AREA

ECIP

TABLE OF CONTENTS

INSTALL BOILERS AND WATER HEATERS
300 AREA, FORT BELVOIR, VIRGINIA

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

1.0 INTRODUCTION

An Energy Savings Opportunity Survey (ESOS) was done in 1991 to improve energy efficiency by analyzing demand of steam in the 300 area and recommending an alternative to central plant #332 during summer, non-heating months.

2.0 DESCRIPTION OF ECOS

The data collected was subjected to a detailed analysis based on Army criteria for qualifying for ECIP projects. Local distillate (#2) oil boilers will be installed in the following buildings:

307	331
309	357
317	362
327	363

Domestic hot water heaters will be installed in the following buildings:

334	365

The cost of this project is $669,132 (FY 1992)

3.0 POTENTIAL ENERGY SAVINGS

The alternative recommended above has a potential savings in energy consumption of 30,459 mbtu per year at a cost savings of $208,278 per year.

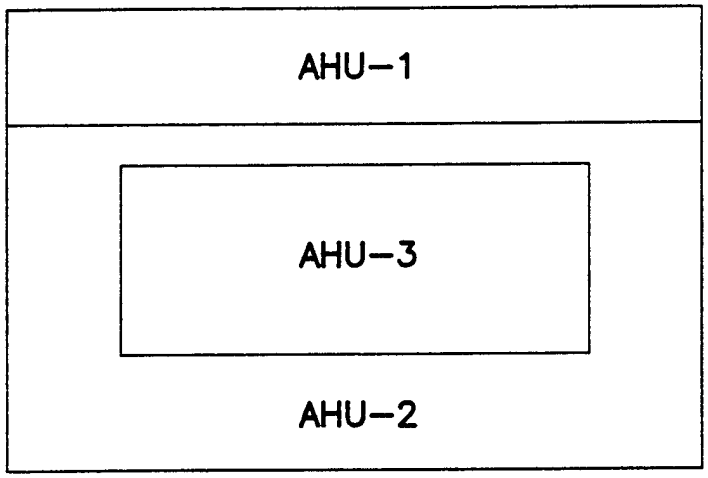
3.1 Metering

At present, there is no provision for metering of the energy consumption of the systems affected by this project. The energy conservation measures recommended are based on field surveys, interviews with the operating personnel, and the Building 332 Engineering Log.

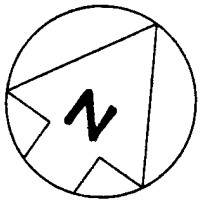
3.1.1 Calculations for energy savings were subjected to rigorous analysis, as per guidelines. However, the energy savings accrued will depend on the implementation as recommended, and following recommended operational, maintenance, and repair.

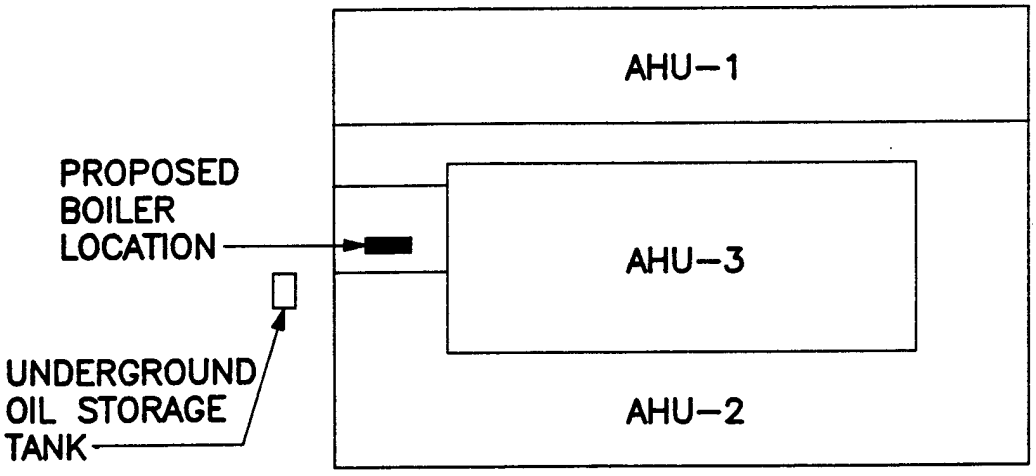
N

300 AREA
FORT BELVOIR, VIRGINIA



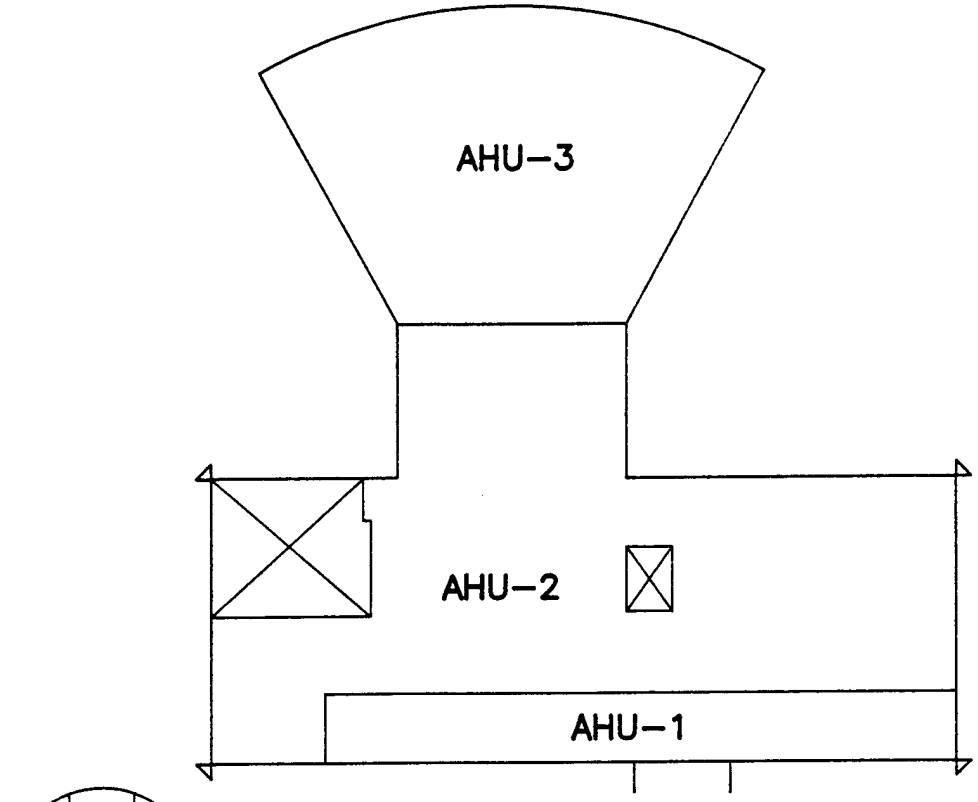
SECOND FLOOR PLAN



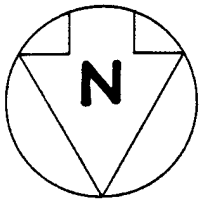


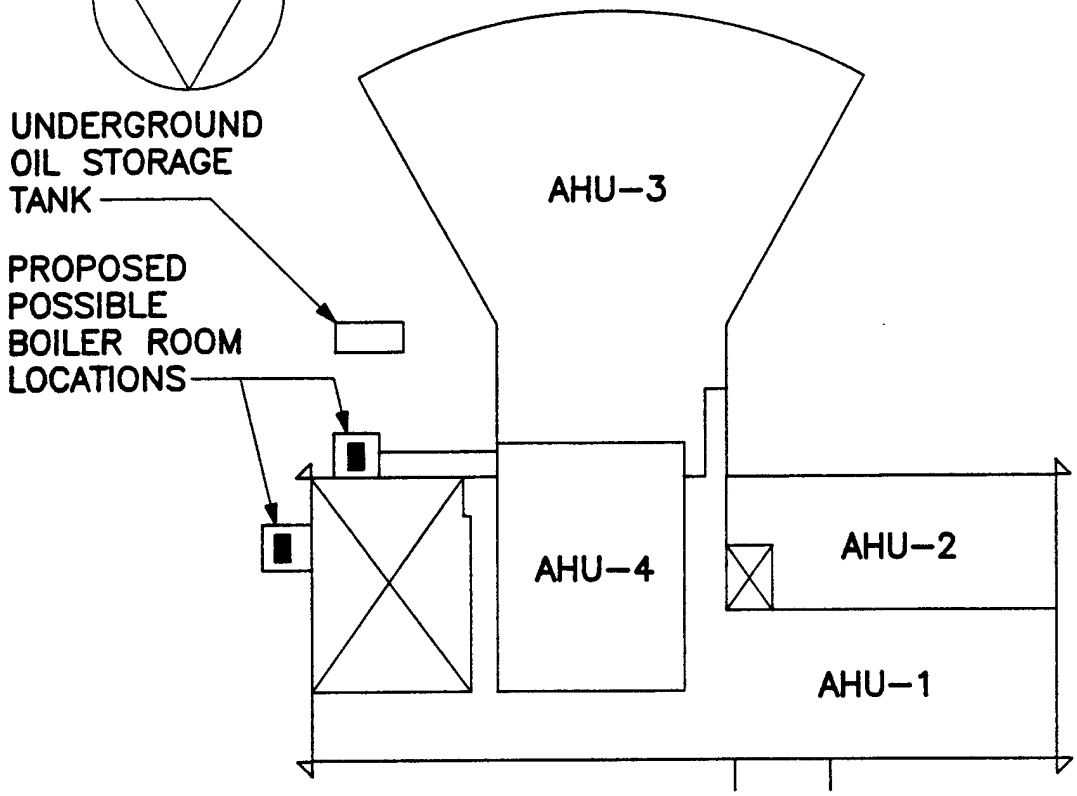
FIRST FLOOR PLAN

BUILDING 307 KEY PLAN



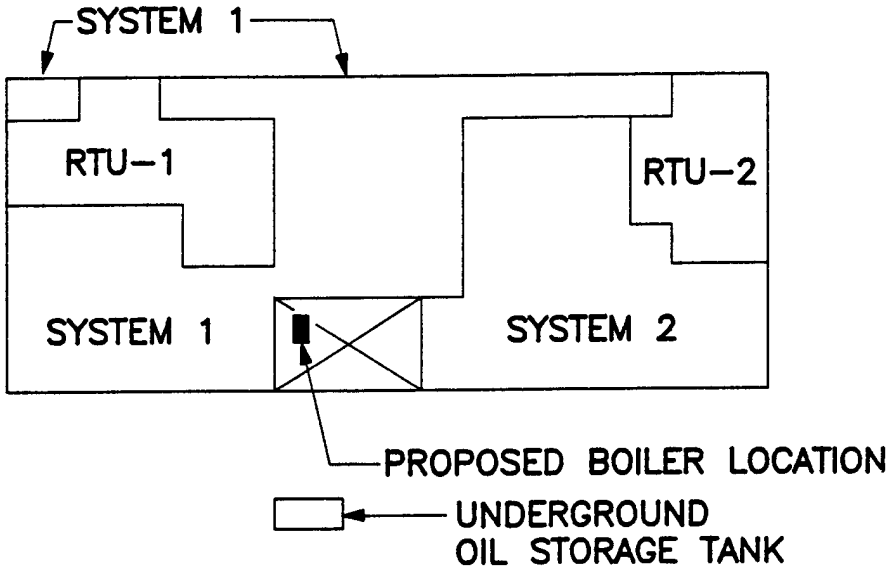
SECOND FLOOR PLAN



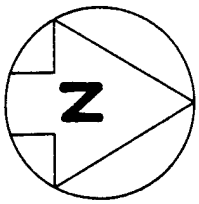


FIRST FLOOR PLAN

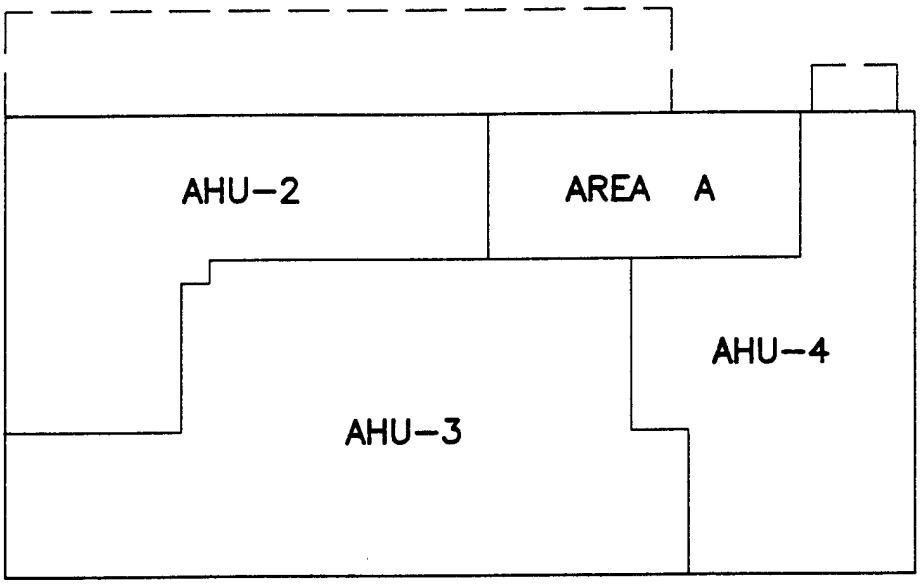
BUILDING 309 KEY PLAN

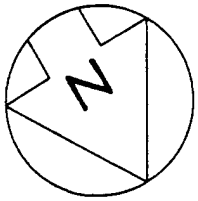


FLOOR PLAN

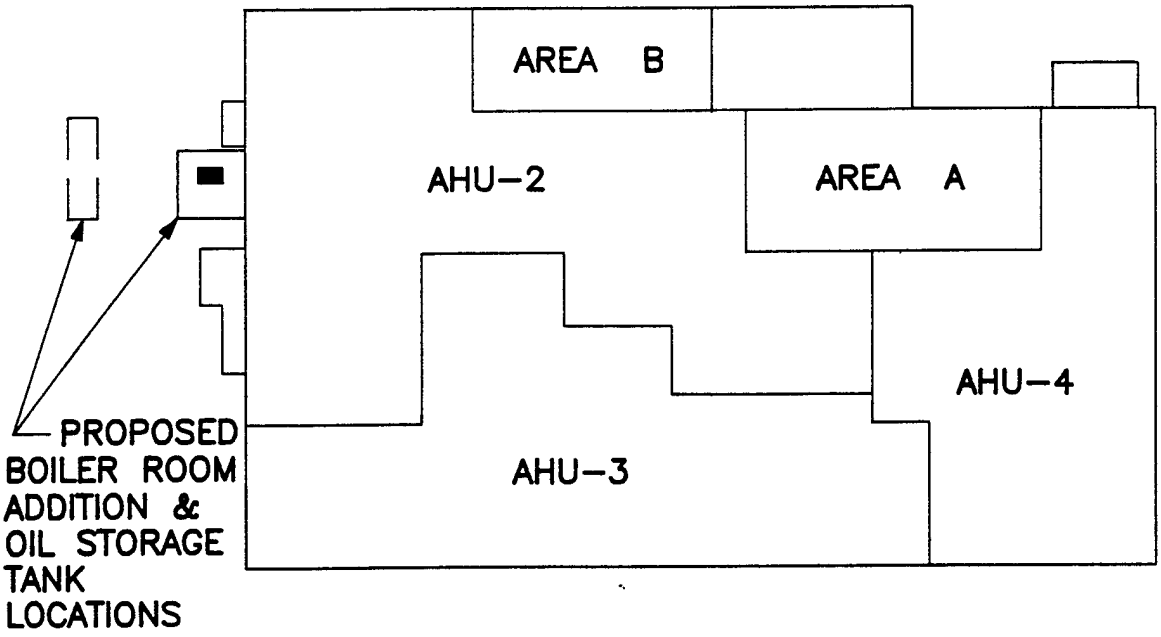


BUILDING 317 KEY PLAN



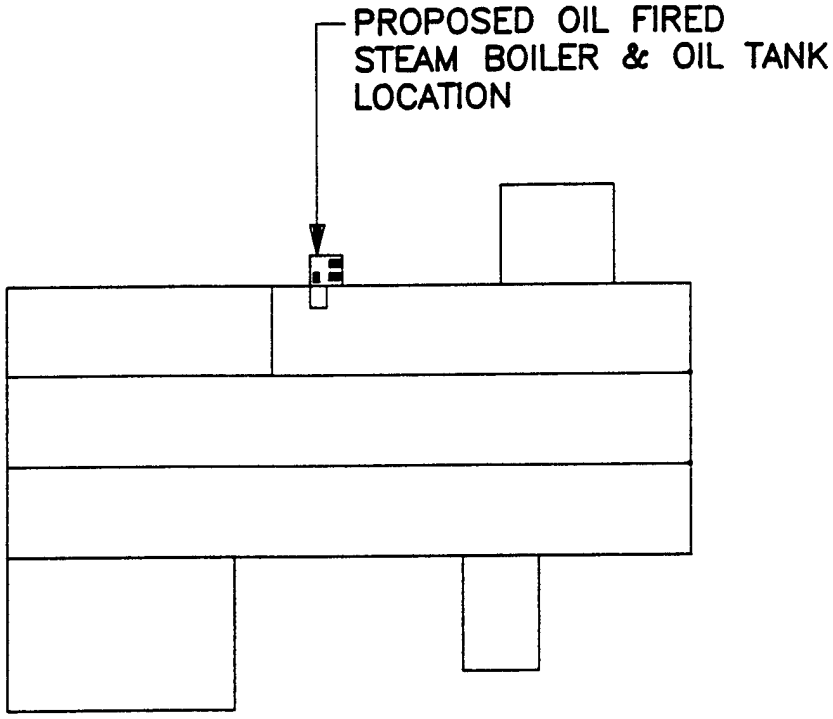


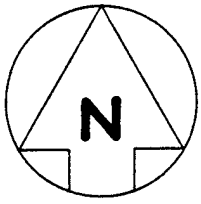
MEZZANINE FLOOR PLAN



FIRST FLOOR PLAN

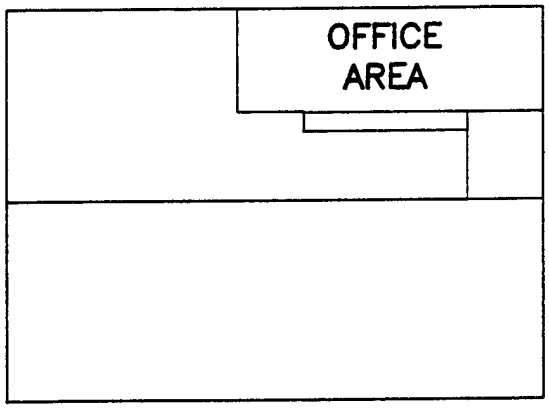
BUILDING 327 KEY PLAN

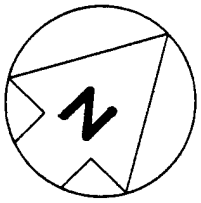




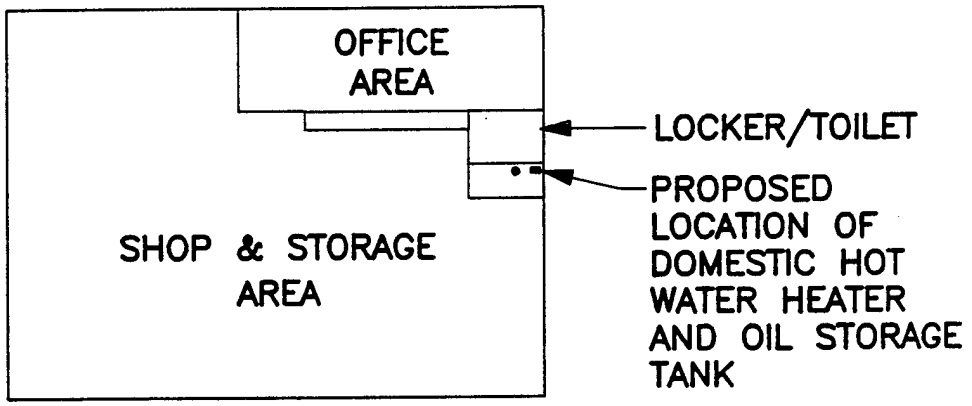
FIRST FLOOR PLAN

BUILDING 331 KEY PLAN



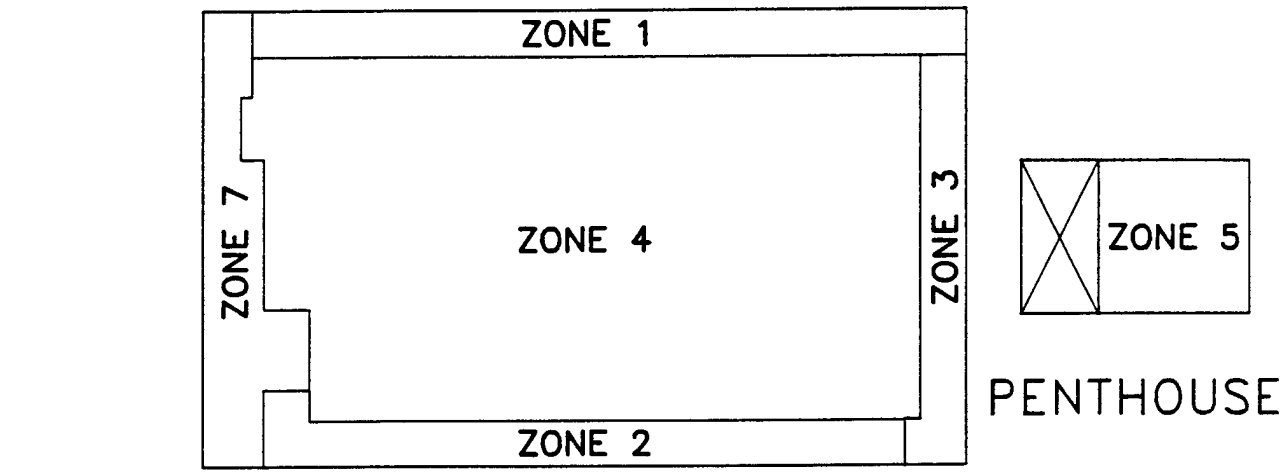


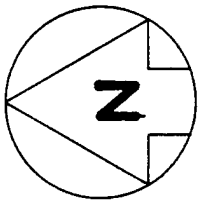
MEZZANINE FLOOR PLAN



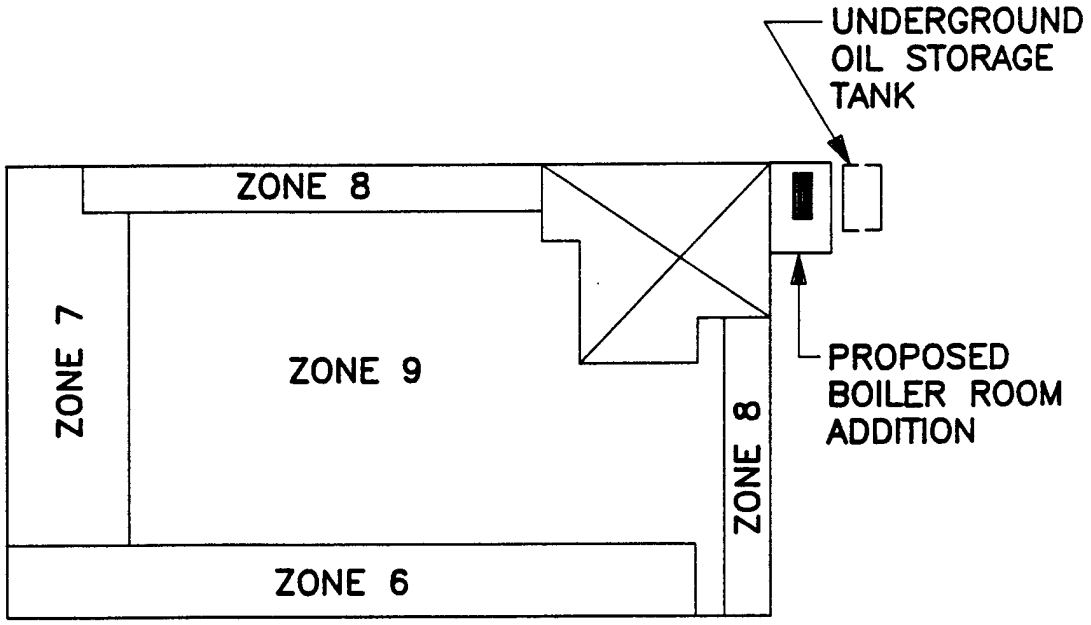
FIRST FLOOR PLAN

BUILDING 334 KEY PLAN



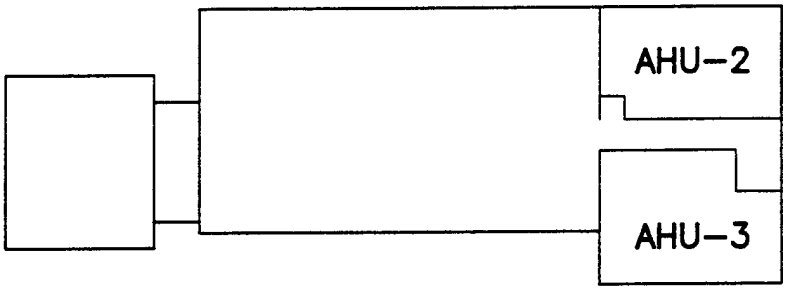


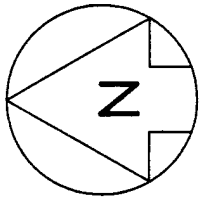
UPPER LEVEL FLOOR PLAN



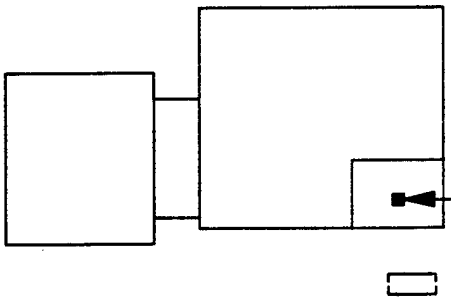
LOWER LEVEL FLOOR PLAN

BUILDING 357 KEY PLAN



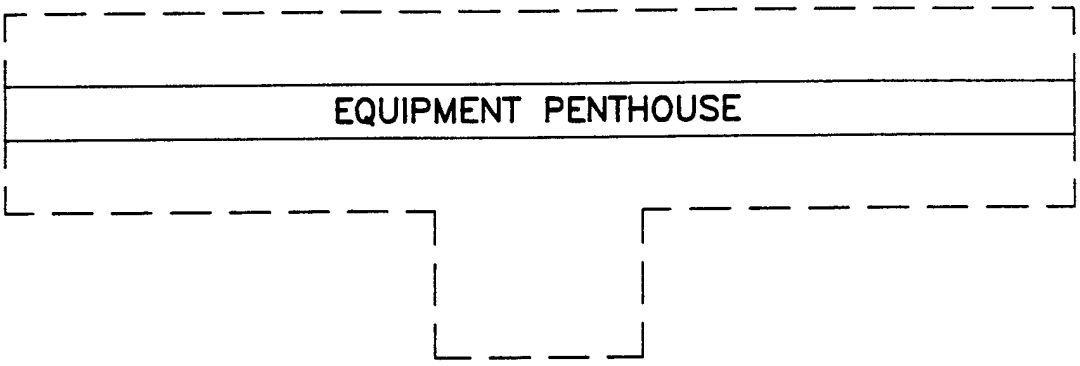


FIRST FLOOR PLAN

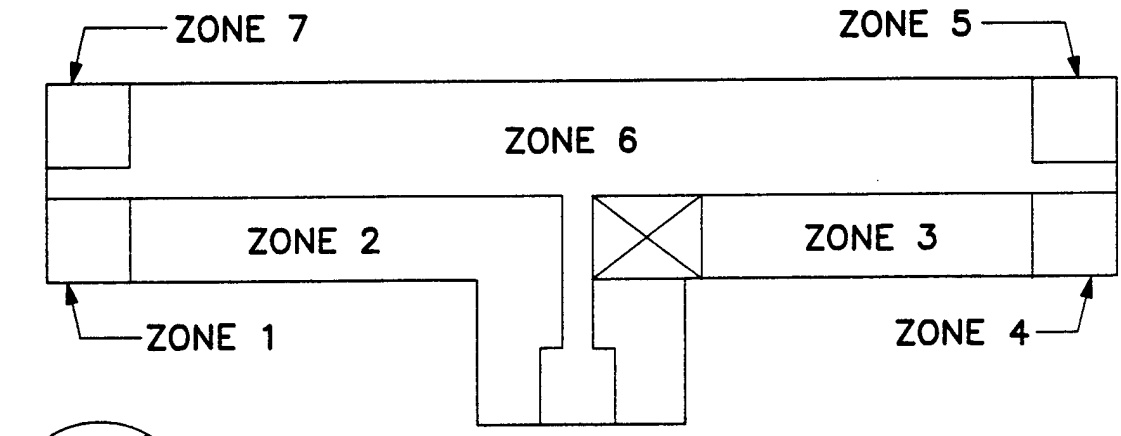


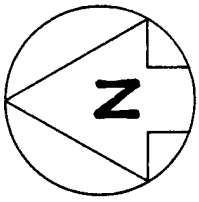
BASEMENT FLOOR PLAN

BUILDING 362 KEY PLAN

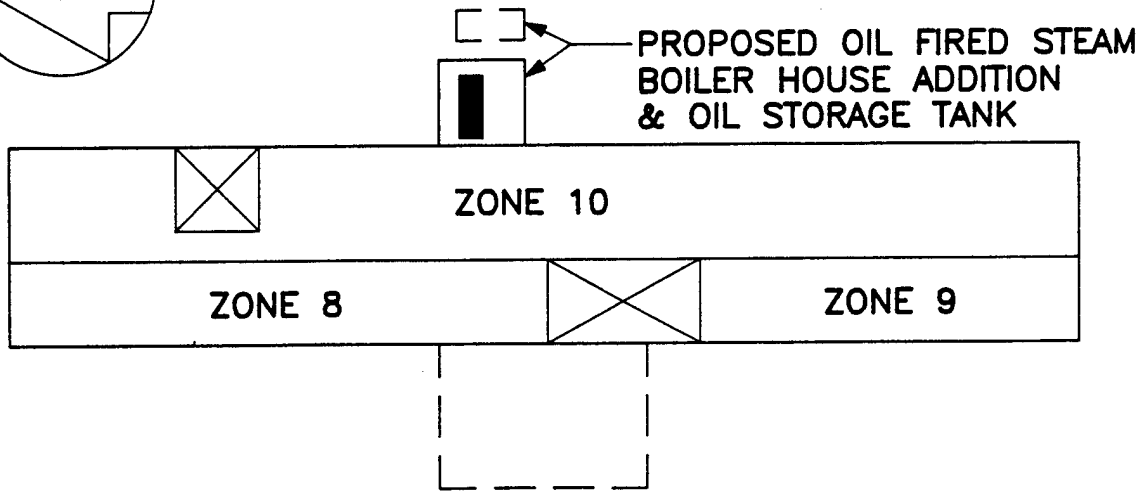


PENTHOUSE PLAN



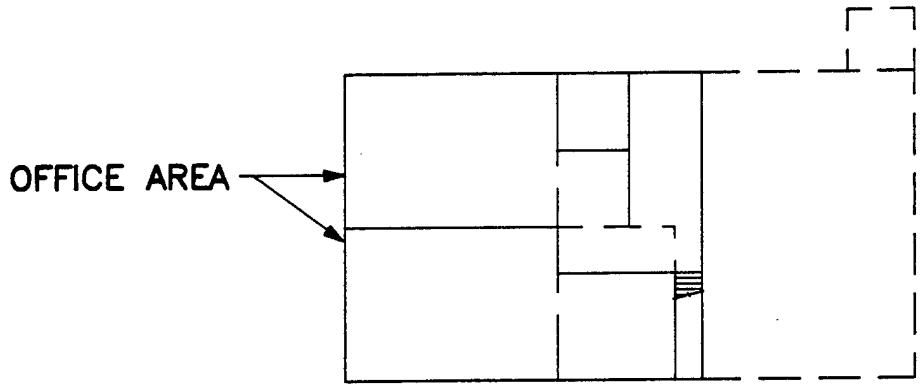


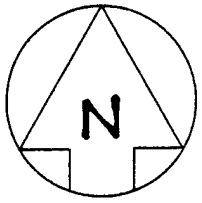
FIRST FLOOR PLAN



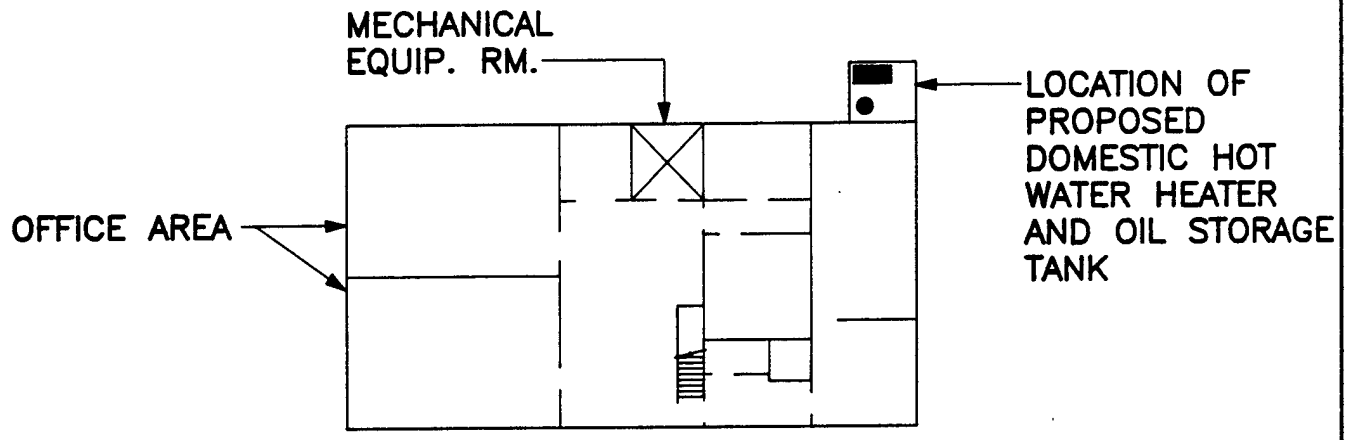
BASEMENT FLOOR PLAN

BUILDING 363 KEY PLAN





MEZZANINE FLOOR PLAN



FIRST FLOOR PLAN

BUILDING 365 KEY PLAN

1. COMPONENT	FY 1993 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE
ARMY		August 29, 1991

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
Fort Belvoir, Virginia	Install boilers and water heaters, 300 area

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST
	80000		

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Install oil boilers in buildings:				545.562
Building Nos. 307, 309, 317, 327, 331, 357, 362, and 363				
Hot water heaters in buildings:				
Building Nos. 334, and 365				
Contingency (10%)				54.556
Total Contract Cost				600.118
Supervision, Inspection & Overhead (5.5%)				33.007
Design (6%)				36.007
Total Request				669.132

10. **Description of Proposed Construction:**

The proposed project consists of installing oil-fired boilers and water heaters for summer use, to allow the central heating plant in Building 332 to be shut down during non-heating months.

11. **Project:**

This project will provide boilers and water heaters for summer use in 10 buildings at Fort Belvoir, Virginia.

Requirement: The project will help Fort Belvoir to reduce energy costs to comply with the Energy Resources Management Plan (ERMP) and reduce dependence on critical fuels, while maintaining operational readiness.

Current Situation: In order to meet summer use requirements of steam in these buildings, the central plant is operated during non-heating months and thus is wasting energy.

1. COMPONENT	FY 1993 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE
ARMY		August 29, 1991

3. INSTALLATION AND LOCATION

Fort Belvoir, Virginia

4. PROJECT TITLE	5. PROJECT NUMBER
Install boilers and water heaters, 300 area	

Impact if Not Provided: If this project is not executed, Fort Belvoir will not achieve annual savings of $288,278 and a potential reduction in energy consumption of 30,459 Mbtu. The base will also fail to contribute to energy conservation goals established for US Army facilities by the Army headquarters.

Estimated Construction Start: October 1993 Index: 1922

Estimated Midpoint Construction: January 1994 Index: 1938

Estimated Construction Completion: April 1994 Index: 1947

Detailed Justifications

D-1 General: The project is dictated by the Army's goal to reduce energy consumption by making efficient use of energy resources at the facilities. This will reduce dependence on critical fuel resources without affecting the mission of the base and, at the same time, increasing the base's capability to achieve budgetary reductions.

D-2 Accommodations Now in Use: Under the existing arrangement, the Central Plant in Building #332 is operated year round. During summer (non-heating) months this plant has to run to meet steam demand in only 10 buildings, thus requiring inefficient operation and wasting energy.

D-3 Analysis of Deficiency: The inefficient operation of the boiler plant in Building #332 contributes towards an estimated wastage of 30,459 Mbtu per year.

D-4 Consideration of Alternatives: Various options have been evaluated thoroughly under an Energy Savings Opportunity Survey (ESOS). The recommended option for this project is feasible and meets predetermined economic criteria.

D-5 Criteria for Proposed Project: The installation will be performed as per applicable codes, rules and regulations.

D-6 Program for Related Equipment: All required equipment will be furnished and installed as a part of this project.

D-7 Disposal of Present Assets: None of the existing assets will need disposal.

1. COMPONENT	FY 1993 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE
ARMY		August 29, 1991

3. INSTALLATION AND LOCATION	
Fort Belvoir, Virginia	
4. PROJECT TITLE	5. PROJECT NUMBER
Install boilers and water heaters, 300 area	

D-8 Survival Measures: Not applicable.

D-9 Summary of Environmental Consequences: Environmental impact of this project is only beneficial. Reduced energy usage will conserve resources used in generation of electricity and also result in reduction of emissions from the power plants.

D-10 Evaluation of Flood Hazard and Encroachment of Wetlands: Not applicable.

D-11 Economic Justification: Completion of the proposed project will result in net energy savings of 30,459 Mbtu and $288,278 annually.

D-12 Utility and Telecommunication Support: No additional utility or telecommunication support is required.

D-13 Protection of Historic Places and Archeological Sites: None of the project elements has any impact on the historic character of any facility.

D-14 Project Development Brochure: An engineering study was completed in August 1991, and an executive summary is attached.

D-15 Energy Requirements: The subject project will reduce present energy consumption by 30,459 Mbtu annually. See Energy Requirements Appraisal (ERA) in Special Requirements Paragraph 3 (SRP-3).

D-16 Provision for the Handicapped: The proposed project does not impact the architectural character of the buildings involved and, hence, no design for the handicapped is involved.

D-17 Real Property Maintenance Activity (RPMA) Analysis:

A. Physical Impact: There will be no increase or decrease in maintenance activity or real property inventory.

B. Backlog of Maintenance and Repair (BMAR) Impact: The system's expectancy will not be affected. Thee will be no impact on BMAR.

D-18 Commercial Activities: The proposed project affects only summer steam requirements of existing activities and does not involve expansion of any facilities for any new function.

1. COMPONENT	FY 1993 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE
ARMY		August 29, 1991

3. INSTALLATION AND LOCATION	
Fort Belvoir, Virginia	
4. PROJECT TITLE	5. PROJECT NUMBER
Install boilers and water heaters, 300 area	

Special Requirements Paragraph 3 (SRP3):

Energy Requirements Appraisal (ERA)

1. Project Description: Oil-fired boilers and water heaters will be installed in the buildings named in Block 9 at Fort Belvoir, Virginia.

2. Estimated Energy Consumption: The existing systems consume an estimated 97,222 Mbtu annually. The project, when fully implemented, will generate net annual energy savings of 30,459 Mbtu.

3. Energy Sources: The use of residual (#6) oil will decrease and that of distillate (#2) oil will increase during summer months.

4. Energy Use Impacts: The proposed project will reduce the burden on existing fuel distribution system.

5. Energy Conservation: The annual energy consumption will be reduced by 30,459 Mbtu annually. Also, Fort Belvoir and, hence, the Army, will be benefitted by an annual cost savings of $288,278.

6. Energy Alternatives: The proposed retrofit will reduce energy consumption by 30% without affecting base mission.

7. Energy Effects: The proposed improvements have a positive environmental effect. By reducing demand for energy, it effectively impacts consumption of non-renewable fuel sources and resulting polluting emissions from electric generation.

8. Basis of Approval: Total energy requirements and alternative fuel sources have been considered and included in this appraisal or discarded as inapplicable.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT BELVOIR REGION NO. 3 PROJECT NUMBER DACA-31-89-C-0198

PROJECT TITLE: ENERGY SAVINGS OPPORTUNITY SURVEY FISCAL YR. 1991

DISCRETE PORTION NAME #300 AREA - LOCAL BOILERS VS. #332

ANALYSIS DATE August '91 ECONOMIC LIFE 25 YEARS PREPARED BY EAC

1. INVESTMENT
   - A. CONSTRUCTION COST $ 545,562
   - B. SIOH $ 30,000
   - C. DESIGN COST $ 32,750
   - D. SALVAGE VALUE - $ _____
   - E. TOTAL INVESTMENT (1A + 1B + 1C - 1D) $ 608,312

2. ENERGY SAVINGS (+) / COST (-)
   ANALYSIS DATE ANNUAL SAVINGS, UNIT COST AND DISCOUNTED SAVINGS

	FUEL	COST $/MBTU/YR(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A.	ELEC	$ 18.05	566	$ 10216	15.61	$ 159472
B.	DIST	$ 7.43	-19702	$ -146386	21.66	$ -3170721
C.	RESID	$ 6.62	49595	$ 328318	26.51	$ 8703710
D.	NG	$ 5.33		$		$
E.	COAL	$		$		$
	TOTAL		30,459	$ 192148		$ 5,692,461

NONENERGY SAVINGS (+) / COST (-)

- A. ANNUAL RECURRING (+/-) $ 96,130
  - (1) DISCOUNT FACTOR (TABLE A) 14.53
  - (2) DISCOUNTED SAVING/COST (3A X 3A1) $ 1,396,769
- B. NONRECURRING SAVINGS (+) / COST (-)

ITEM		SAVINGS (+) COST (-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
(1)	_____	$			$
(2)	_____	$			$
(3)	_____	$			$
(4)	TOTAL	$			$

- C. TOTAL NONENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) $ 1,396,769
- D. PROJECT NONENERGY QUALIFICATION TEST
  - (1) 25% MAX NONENERGY CALC (2F5 x .33) $ 1,878,512
    - a. IF 3D1 IS = OR > 3C GO TO ITEM 4
    - b. IF 3D1 IS < 3C CALC S1R = (2F5+3D1) - 1E = _____
    - c. IF 3D1 IS = > 1 GO TO ITEM 4
    - D. IF 3D1 IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3 + 3A + (3B1d ÷ YEARS ECONOMIC LIFE) $ 288,278

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 7,089,230

DISCOUNTED SAVINGS RATION (IF < 1 PROJECT DOES NOT QUALIFY) (S1R) = (5÷1E) = 11.6

SIMPLE PAYBACK PERIOD (YEARS) = 2.1

OIL TO GAS CONVERSION

900 AREA (DOGUE CREEK)

PECIP

PROJECT DOCUMENTATION
FOR
PRODUCTIVITY ENHANCING CAPITAL INVESTMENT PROGRAM (PECIP) PROJECTS

PROJECT NAME: Oil to Gas Conversion #900 Area

Date: August 29, 1991

BUILDINGS AND PROJECT DESCRIPTION: Housing Area #900 (Dogue Creek), as described below

PROJECT LOCATION: Fort Belvoir, Virginia

1. BRIEF DESCRIPTION OF PROJECT: Converting the energy source for heating and domestic hot water to gas. It is proposed to implement oil to gas conversion in conjunction with an on-going renovation project. Existing oil furnaces and electric water heaters will be replaced by gas-fired furnaces and water heaters in the units listed on pages 3 through 8. This is the incremental cost of gas fired equipment as compared to the oil furnaces and electric water heaters. The project should be implemented in conjunction with PN 24566, the design of which is under way by the Norfolk District Corps of Engineers.

2. BRIEF DESCRIPTION OF THE REASONS FOR THE MODIFICATIONS: Conversion to gas is expected to provide reductions in energy costs based on energy projections.

3. SPECIFIC INSTRUCTIONS FOR PERFORMING THE MODIFICATION: Replace the existing oil furnaces and electric water heaters with gas fired equipment in all of the 270 housing units in 45 buildings in the 900 area (Dogue Creek) at Fort Belvoir, Virginia.

4. ESTIMATED DOLLAR AND ENERGY SAVINGS PER YEAR:

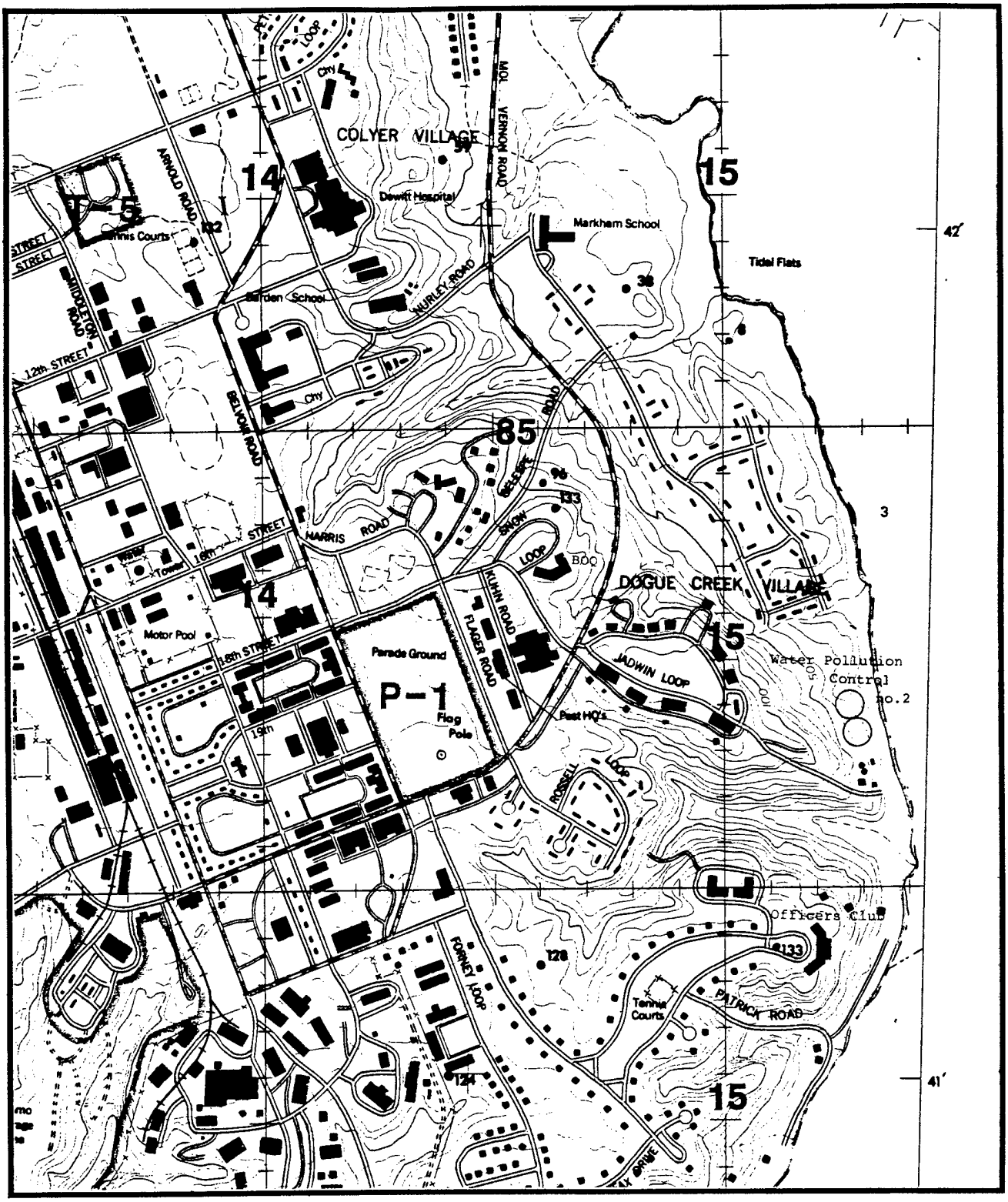
   A. The estimated dollar savings per year for this project are:

   $75,857

   B. The estimated energy savings per year for this project are:

Electricity	3,680	MBTU
Distillate Fuel Oil	12,605	MBTU
Natural Gas	-16,308	MBTU
Total	-23	MBTU

5. See attached DA Form 5108-R.



DOGUE CREEK HOUSING AREA
FORT BELVOIR, VIRGINIA

Dogue Creek Village

Bldg No.		Location	Bed-rooms	Sq Ft	Year
900	A	Barlow Road	2	1,137	56
	B	Barlow Road	2	1,137	56
	C	Barlow Road	2	1,137	56
	D	Barlow Road	2	1,137	56
	E	Barlow Road	3/B	1,264	56
901	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
	F	Barlow Road	3/B	1,264	56
902	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	2	1,137	56
	C	Barlow Road	2	1,137	56
	D	Barlow Road	2	1,137	56
	E	Barlow Road	2	1,137	56
903	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
904	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
905	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
906	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
907	A	Fenner Road	3/B	1,264	56
	B	Barlow Road	2	1,137	56
	C	Barlow Road	2	1,137	56
	D	Barlow Road	2	1,137	56

Bldg No.		Location	Bedrooms	Sq Ft	Year
907	E	Barlow Road	2	1,137	56
	F	Barlow Road	3	1,264	56
	G	Barlow Road	3	1,264	56
	H	Barlow Road	3	1,264	56
	I	Barlow Road	3	1,264	56
908	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
	F	Barlow Road	3/B	1,264	56
909	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
910	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
911	A	Barlow Road	3	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3/B	1,264	56
912	A	Barlow Road	3	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	2/B	1,137	56
913	A	Barlow Road	3/B	1,264	56
	B	Moyer Road	3	1,264	56
	C	Moyer Road	3	1,264	56
	D	Moyer Road	3	1,264	56
	E	Moyer Road	3	1,264	56
914	A	Moyer Road	3	1,264	56
	B	Moyer Road	3	1,264	56
	C	Moyer Road	3	1,264	56
	D	Moyer Road	3	1,264	56
	E	Moyer Road	2	1,137	56
	F	Moyer Road	2	1,137	56
	G	Moyer Road	2	1,137	56
	H	Moyer Road	2	1,137	56
	I	Moyer Road	3	1,264	56
915	A	Maloney Road	2	1,137	56
	B	Maloney Road	2	1,137	56
	C	Maloney Road	2	1,137	56
	D	Maloney Road	2	1,137	56
	E	Maloney Road	3/B	1,264	56
916	A	Maloney Road	3/B	1,264	56

Bldg No.		Location	Bed-rooms	Sq Ft	Year
916	B	Maloney Road	3	1,264	56
	C	Maloney Road	3	1,264	56
916	D	Maloney Road	3	1,264	56
	E	Maloney Road	3	1,264	56
	F	Maloney Road	3/B	1,264	56
917	A	Maloney Road	3/B	1,264	56
	B	Maloney Road	2	1,137	56
	C	Maloney Road	2	1,137	56
	D	Maloney Road	2	1,137	56
	E	Maloney Road	2	1,137	56
918	A	Maloney Road	2/B	1,264	56
	B	Maloney Road	2	1,264	56
	C	Maloney Road	2	1,264	56
	D	Maloney Road	2	1,264	56
	E	Maloney Road	3	1,264	56
919	A	Moyer Road	3/B	1,264	56
	B	Maloney Road	2	1,137	56
	C	Maloney Road	2	1,137	56
	D	Maloney Road	2	1,137	56
	E	Maloney Road	2	1,137	56
	F	Maloney Road	3	1,264	56
	G	Maloney Road	3	1,264	56
	H	Maloney Road	3	1,264	56
	I	Maloney Road	3	1,264	56
920	A	Maloney Road	3/B	1,264	56
	B	Maloney Road	3	1,264	56
	C	Maloney Road	3	1,264	56
	D	Maloney Road	3	1,264	56
	E	Maloney Road	3	1,264	56
	F	Maloney Road	3/B	1,264	56
921	A	Maloney Road	3/B	1,264	56
	B	Maloney Road	3	1,264	56
	C	Maloney Road	3	1,264	56
	D	Maloney Road	3	1,264	56
	E	Maloney Road	3	1,264	56
922	A	Maloney Road	3	1,264	56
	B	Maloney Road	3	1,264	56
	C	Maloney Road	3	1,264	56
	D	Maloney Road	3	1,264	56
	E	Maloney Road	2	1,137	56
	F	Maloney Road	2	1,137	56
	G	Maloney Road	2	1,137	56
	H	Maloney Road	2	1,137	56
923	A	Maloney Road	3	1,264	56
	B	Maloney Road	3	1,264	56
	C	Maloney Road	3	1,264	56
	D	Maloney Road	3	1,264	56
	E	Maloney Road	3/B	1,264	56
924	A	Maloney Road	2	1,137	56
	B	Maloney Road	2	1,137	56
	C	Maloney Road	2	1,137	56

Bldg No.		Location	Bed-rooms	Sq Ft	Year
924	D	Maloney Road	2	1,137	56
	E	Maloney Road	3/B	1,264	56
925	A	Maloney Road	3	1,264	56
	B	Maloney Road	3	1,264	56
	C	Maloney Road	3	1,264	56
	D	Maloney Road	3	1,264	56
	E	Maloney Road	3/B	1,264	56
926	A	Maloney Road	3/B	1,264	56
	B	Maloney Road	2	1,137	56
	C	Maloney Road	2	1,137	56
	D	Maloney Road	2	1,137	56
	E	Maloney Road	2	1,137	56
	F	Maloney Road	3/B	1,264	56
927	A	Maloney Road	3/B	1,264	56
	B	Maloney Road	3	1,264	56
	C	Maloney Road	3	1,264	56
	D	Maloney Road	3	1,264	56
	E	Maloney Road	3	1,264	56
928	A	Fenner Road	3	1,264	56
	B	Fenner Road	3	1,264	56
	C	Fenner Road	3	1,264	56
	D	Fenner Road	3	1,264	56
	E	Fenner Road	2	1,137	56
	F	Maloney Road	2	1,137	56
	G	Maloney Road	2	1,137	56
	H	Maloney Road	2	1,137	56
929	A	Maloney Road	3/B	1,264	56
	B	Fenner Road	3	1,264	56
	C	Fenner Road	3	1,264	56
	D	Fenner Road	3	1,264	56
	E	Fenner Road	3	1,264	56
930	A	Fenner Road	3	1,264	56
	B	Fenner Road	3	1,264	56
	C	Fenner Road	3	1,264	56
	D	Fenner Road	3	1,264	56
	E	Fenner Road	3/B	1,264	56
931	A	Fenner Road	3	1,264	56
	B	Fenner Road	3	1,264	56
	C	Fenner Road	3	1,264	56
	D	Fenner Road	3	1,264	56
	E	Fenner Road	3/B	1,264	56
932	A	Fenner Road	3/B	1,264	56
	B	Fenner Road	3	1,264	56
	C	Fenner Road	3	1,264	56
	D	Fenner Road	3	1,264	56
	E	Fenner Road	3	1,264	56
933	A	Barlow Road	3	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	2	1,137	56

Bldg No.		Location	Bed-rooms	Sq Ft	Year
933	F	Barlow Road	2	1,137	56
	G	Barlow Road	2	1,137	56
933	H	Barlow Road	2	1,137	56
	I	Barlow Road	3/B	1,264	56
934	A	Barlow Road	3	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	2	1,137	56
	F	Barlow Road	2	1,137	56
	G	Barlow Road	2	1,137	56
	H	Barlow Road	2	1,137	56
	I	Barlow Road	3/B	1,264	56
935	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
	F	Barlow Road	3/B	1,264	56
936	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	2	1,137	56
	C	Barlow Road	2	1,137	56
	D	Barlow Road	3	1,137	56
	E	Barlow Road	2	1,137	56
	F	Barlow Road	3	1,264	56
	G	Barlow Road	3	1,264	56
	H	Barlow Road	3	1,264	56
	I	Barlow Road	3	1,264	56
937	A	Barlow Road	3	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3/B	1,264	56
938	A	Barlow Road	3	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	2	1,189	56
	F	Barlow Road	2	1,189	56
	G	Barlow Road	2	1,189	56
	H	Barlow Road	2	1,189	56
	I	Barlow Road	3/B	1,264	56
939	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	3	1,264	56
	C	Barlow Road	3	1,264	56
	D	Barlow Road	3	1,264	56
	E	Barlow Road	3	1,264	56
	F	Barlow Road	3/B	1,264	56
940	A	Barlow Road	3/B	1,264	56
	B	Barlow Road	2	1,137	56
	C	Barlow Road	2	1,137	56

Bldg No.	Location	Bed-rooms	Sq Ft	Year
940 D	Barlow Road	2	1,137	56
E	Barlow Road	2	1,137	56
940 F	Barlow Road	3	1,264	56
G	Barlow Road	3	1,264	56
H	Barlow Road	3	1,264	56
I	Barlow Road	3	1,264	56
941 A	Barlow Road	3/B	1,264	56
B	Barlow Road	3	1,264	56
C	Barlow Road	3	1,264	56
D	Barlow Road	3	1,264	56
E	Barlow Road	3	1,264	56
942 A	Barlow Road	3	1,264	56
B	Barlow Road	3	1,264	56
C	Barlow Road	3	1,264	56
D	Barlow Road	3	1,264	56
E	Barlow Road	3/B	1,264	56
943 A	Barlow Road	3/B	1,264	56
B	Barlow Road	3	1,264	56
C	Barlow Road	3	1,264	56
D	Barlow Road	3	1,264	56
E	Barlow Road	3	1,264	56
944 A	Barlow Road	3	1,264	56
B	Barlow Road	3	1,264	56
C	Barlow Road	3	1,264	56
D	Barlow Road	3	1,264	56
E	Barlow Road	3/B	1,264	56

DOCUMENTATION FOR PRODUCTIVITY CAPITAL INVESTMENT PROGRAMS

For use of this form, see AR 5-4,the proponent agency is OCA

1. PROJECT NO.

REQUIREMENT CONTROL SYMBOL
DD-M(R) 1561

2. TO	3. THRU	4. FROM	5. DOD COMP NAME	6. DOD COMP CODE
			7. COMMAND CODE	8. DATE

9. PROJECT TITLE

Fuel Conversion, 900 Area, (Dogue Creek)
Fort Belvoir, Virginia

10. TYPE OF PROJECT (Check one)

/ / QRIP / / OSD PIF /X/ PECIP

11. AMORTIZATION YEARS/MONTHS

$ 217,130 / $75,857 X 12
(Proj. Cost) (Av.Ann.Savings) (Mo.)

= 2 or 10 (amortization)
(years) (months)

12. FUNCTIONAL AREA WHERE SAVINGS WILL OCCUR

Army Energy Management

13. ECONOMIC LIFE

See 20

14. EXPECTED OPERATIONAL DATE

15. SUBMITTING UNIT(S)	16. UNIT ID CODE	17. PROJECT DESCRIPTION
Fort Belvoir, Virginia		Convert energy source for heating and domestic hot water to natural gas.

18. DETAILED JUSTIFICATION

The average savings achieved are estimated to be $75,857 per year.

19. SAVINGS DISPOSITION

The savings achieved from this conversion will reduce energy cost to Fort Belvoir. While electric energy and distallate oil use will be reduced, natural gas consumption will increase by $86,922 per year.

20. OTHER REMARKS (Continue on page 5, if more space is needed)

DA FORM 5108-R, MAY 82

21a. SUMMARY OF DOLLAR SAVINGS
(ROUND OFF TO THE NEAREST DOLLAR)

Attach computation sheet identifying the method and source of data for savings

SAVINGS BREAKOUT	PRESENT METHOD	PROPOSED METHOD				DIFFERENCE/SAVINGS			
		1ST YR	2D YR	3D YR	4TH YR	1ST YR	2D YR	3D YR	4TH YR
SALARY/LABOR/ OVERTIME	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MATERIAL/ SUPPLIES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
UTILITIES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MAINTENANCE/ REPAIR	$10,800	$8,100	$8,100	$8,100	$8,100	$2,700	$2,700	$2,700	$2,700
TRANSPORTATION	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LEASE COSTS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SALVAGE/ TURN-IN	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ENERGY *(Identify)* ELECTRICITY	$66,424	-0-	-0-	-0-	-0-	$66,424	$66,424	$66,424	$66,424
NATURAL GAS	-0-	$86,922	$86,922	$86,922	$86,922	($86,922)	($86,922)	($86,922)	($86,922)
OTHER *(Identify)* DIST. OIL	$93,655	-0-	-0-	-0-	-0-	$93,655	$93,655	$93,655	$93,655
TOTALS	$170,879	$95,022	$95,022	$95,022	$95,022	$75,857	$75,857	$75,857	$75,857

b. PRIORITIZATION

(1) INTERNAL RATE OF RETURN *(IRR)*

Divide estimated project cost $217,130 by average annual savings $75,857 = 2.9 factor.

Based on factor and number of years economic life of the project, select the IRR from Table H-3, App H, Ch. 5, AR 5-4 = 40 % IRR.

(2) SAVINGS TO INVESTMENT RATIO *(S/I)*

Multiply annual savings _____ X discount factor _____ = $832,929 and divide by present value of investment *(undiscounted)* $217,130 = 3.84 S/I.

(Based on economic life 15 years, select discount factor from Table H-4, App H, Ch. 5, AR 5-4.

(3) RATE OF INVESTMENT PER MANPOWER SPACE *(RIMS)*

Divide estimated project cost _____ by number of manpower space savings _____ = _____ RIMS.

(Manpower requivalents cannot be used in this computation.)

Not applicable. No manpower space savings involved.

Figure H-1. Documentation for Productivity Capital Investment Program (DA Form 5108-R)—Continued.

21a. SUMMARY OF DOLLAR SAVINGS
(ROUND OFF TO THE NEAREST DOLLAR)

Attach computation sheet identifying the method and source of data for savings

SAVINGS BREAKOUT	PRESENT METHOD	PROPOSED METHOD				DIFFERENCE/SAVINGS			
		1ST YR	2D YR	3D YR	4TH YR	1ST YR	2D YR	3D YR	4TH YR
SALARY/LABOR/ OVERTIME	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MATERIAL/ SUPPLIES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
UTILITIES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MAINTENANCE/ REPAIR	$10,800	$8,100	$8,100	$8,100	$8,100	$2,700	$2,700	$2,700	$2,700
TRANSPORTATION	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LEASE COSTS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SALVAGE/ TURN-IN	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ENERGY *(Identify)* ELECTRICITY	$66,424	-0-	-0-	-0-	-0-	$66,424	$66,424	$66,424	$66,424
NATURAL GAS	-0-	$86,922	$86,922	$86,922	$86,922	($86,922)	($86,922)	($86,922)	($86,922)
OTHER *(Identify)* DIST. OIL	$93,655	-0-	-0-	-0-	-0-	$93,655	$93,655	$93,655	$93,655
TOTALS	$170,879	$95,022	$95,022	$95,022	$95,022	$75,857	$75,857	$75,857	$75,857

b. PRIORITIZATION

(1) INTERNAL RATE OF RETURN *(IRR)*

Divide estimated project cost $217,130 by average annual savings $75,857 = 2.9 factor.

Based on factor and number of years economic life of the project, select the IRR from Table H-3, App H, Ch. 5, AR 5-4 = 40 % IRR.

(2) SAVINGS TO INVESTMENT RATIO *(S/I)*

Multiply annual savings _____ X discount factor _____ = $832,929 and divide by present value of investment *(undiscounted)* $217,130 = 3.84 S/I.

(Based on economic life 15 years, select discount factor from Table H-4, App H, Ch. 5, AR 5-4.

(3) RATE OF INVESTMENT PER MANPOWER SPACE *(RIMS)*

Divide estimated project cost _____ by number of manpower space savings _____ = _____ RIMS.

(Manpower requivalents cannot be used in this computation.)

Not applicable. No manpower space savings involved.

Figure H-1. Documentation for Productivity Capital Investment Program (DA Form 5108-R)—Continued.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT BELVOIR REGION NO. 3 PROJECT NUMBER DACA-31-89-C-0198

PROJECT TITLE: ENERGY SAVINGS OPPORTUNITY SURVEY FISCAL YR. 1991

DISCRETE PORTION NAME DOGUE CREEK - OIL TO GAS CONVERSION

ANALYSIS DATE August '91 ECONOMIC LIFE 15 YEARS PREPARED BY EAC

1. INVESTMENT
   - A. CONSTRUCTION COST $ 194,736
   - B. SIOH $ 10,710
   - C. DESIGN COST $ 11,684
   - D. SALVAGE VALUE - $
   - E. TOTAL INVESTMENT (1A + 1B + 1C - 1D) $ 217,130

2. ENERGY SAVINGS (+) / COST (-)
   ANALYSIS DATE ANNUAL SAVINGS, UNIT COST AND DISCOUNTED SAVINGS

	FUEL	COST $/MBTU/YR(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A.	ELEC	$ 18.05	3680	$ 66424	11.11	$ 737,971
B.	DIST	$ 7.43	12605	$ 93655	14.26	$ 1,335,520
C.	RESID	$ 6.62		$		$
D.	NG	$ 5.33	-16308	$ -86922	14.45	$ -1,256,023
E.	COAL	$		$		$
F.	TOTAL		-23	$ 73,157		$ 817,468

3. NONENERGY SAVINGS (+) / COST (-)
   - A. ANNUAL RECURRING (+/-) MAINT. $ 2,700
     - (1) DISCOUNT FACTOR (TABLE A) 10.59
     - (2) DISCOUNTED SAVING/COST (3A X 3A1) $ 28593
   - B. NONRECURRING SAVINGS (+) / COST (-)

ITEM	SAVINGS (+) COST (-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
(1) REPL. ELEC WH	$ 153,900	10	0.63	$ 96,957
(2)	$			$ -110,089
(3) GAS WH	$ -174,745	10	0.63	$
(4) TOTAL	$ -20,845			$ -13,132

   - C. TOTAL NONENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) $ 15,461
   - D. PROJECT NONENERGY QUALIFICATION TEST
     - (1) 25% MAX NONENERGY CALC (2F5 x .33) $ 269,764
       - a. IF 3D1 IS = OR > 3C GO TO ITEM 4
       - b. IF 3D1 IS < 3C CALC S1R = (2F5+3D1) - 1E =
       - c. IF 3D1 IS = > 1 GO TO ITEM 4
       - D. IF 3D1 IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3 + 3A + (3B1d ÷ YEARS ECONOMIC LIFE) $ 74,467

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 832,929

6. DISCOUNTED SAVINGS RATION (IF < 1 PROJECT DOES NOT QUALIFY) (S1R) = (5-1E) = 3.84

SIMPLE PAYBACK PERIOD = 2.9 years

BUILDING 1359 (CONTROL TOWER)

LOW COST PROJECT

BUILDING 1359 (CONTROL TOWER)
FORT BELVOIR, VIRGINIA

DESCRIPTION OF LOW COST PROJECT

1.0 INTRODUCTION

An Energy Savings Opportunity Survey (ESOS) was done in 1991 to improve energy efficiency by recommending feasible architectural, mechanical, and electrical ECOs.

2.0 DESCRIPTION OF ECOS

The data collected was subjected to a detailed analysis based on Army criteria. The following energy conservation opportunities (ECOs) should be implemented:

2.1 Radiator Control Valves

Install control valves on radiators at second floor to prevent overheating.

2.2 Ceiling Insulation

Add insulation in the ceiling of the control tower to reduce heat gain and heat loss.

2.3 Weatherstripping

The door to the mechanical room (first floor) and all windows except those in the control room shall be weatherstripped to reduce infiltration and hence, energy dissipation.

2.4 Night Setback Controls

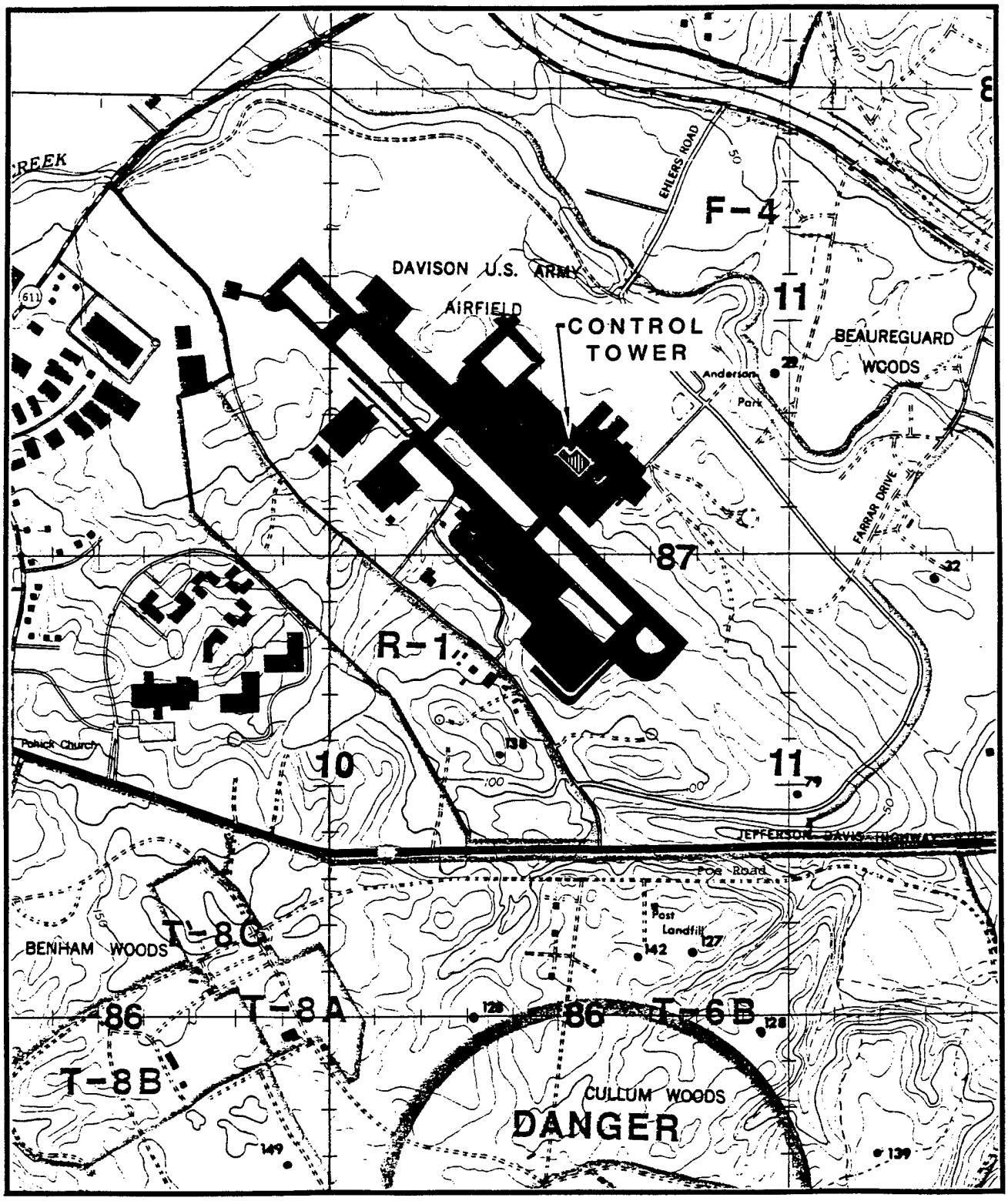
Install clock controls for fan coil units on second, third, fifth, and sixth floors, and an air handling unit on the sixth floor. The air handling unit will be provided with automatic outside air dampers also. This will save energy during unoccupied periods by controlling temperature and outside air.

2.5 Fixture Reflectors

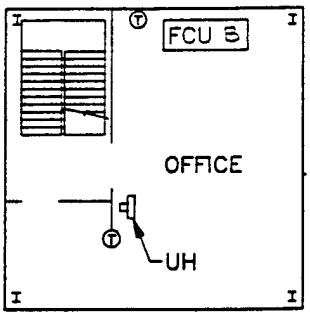
Install reflectors on three fluorescent fixtures on the third floor to reduce electric consumption while maintaining recommended lighting levels.

3.0 POTENTIAL ENERGY SAVINGS AND COST

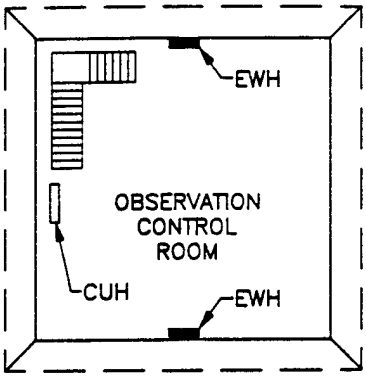
The recommended ECOs have potential savings of 79 Mbtu and $700 per year at a cost of $4,154.



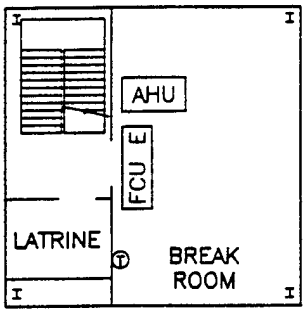
CONTROL TOWER - BUILDING 1359
DAVIDSON AIRFIELD
FORT BELVOIR, VIRGINIA



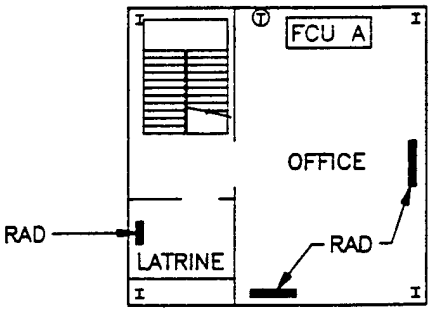
THIRD FLOOR PLAN



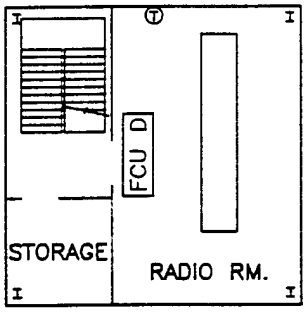
SEVENTH FLOOR PLAN



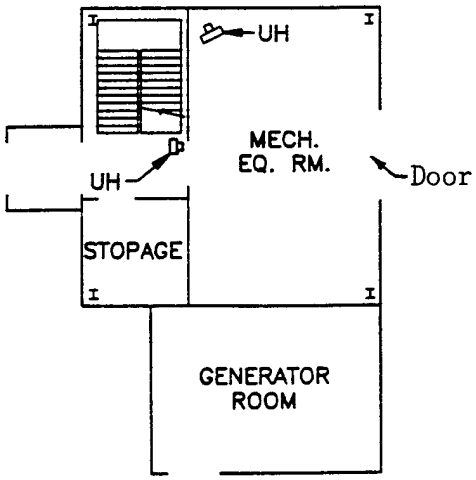
SIXTH FLOOR PLAN

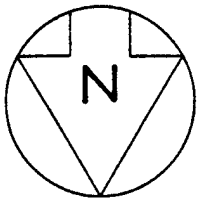


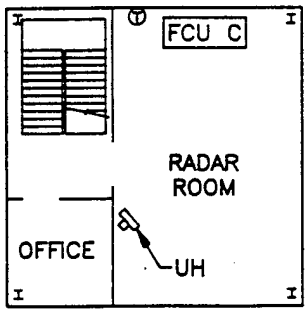
SECOND FLOOR PLAN



FIFTH FLOOR PLAN







GROUND FLOOR PLAN

FOURTH FLOOR PLAN

BUILDING 1359 KEY PLAN

ECO #1

RADIATOR CONTROL VALVES

BUILDING 1359

ECO #1 - Radiator Control Valves

Description - Radiators have steam flowing through them even when the heat is not needed, thus overheating the respective spaces. Control valves will stop the flow of steam when the thermostat set point is reached. These radiators are located on the second floor.

Energy Saved	= 25 MBTU/year
Cost	= $945 (incl. SIOH)*
SIR	= 3.3

* The cost for this ECO has been developed from Means Cost Estimating Guide.

CONSTRUCTION COST ESTIMATE

Project: Energy Savings Opportunity Survey

Location: Control Tower
Building 1359
Fort Belvoir, VA

By: Engineering Applications Consultants

ECO: Install thermostatic radiator control valves

ITEM	QUANTITY Number	Unit	LABOR Per unit	Total	MATERIAL Per unit	Total	TOTAL COST
Install valves	4	each	$10	$40	$94	$376	$416
Remove exist. manual valve	4	each	$30	$120	---	---	$120
Install fittings	8	each	$15	$120	$1	$8	$128
SUB-TOTAL:				$280		$384	$664
Labor Markup: 21%				$59		---	$59
Taxes: 4.5%				---		$17	$17
SUB-TOTAL:				$339		$401	$740
Overhead: 10%				$34		$40	$74
SUB-TOTAL:				$373		$441	$814
Profit: 10%				$37		$44	$81
TOTAL:				$410		$486	$896

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Radiator Control Val — 09-26-91
Prepared By : E A C, PC BURKE, VA. — 60901891.00
E20-II Advanced Economic Analysis Program — Page 1 of 2
LCCID - based (version 1, level 35).

****

STUDY IDENTIFICATION BLOCK

Project Title	:	ESOS
Installation Name	:	FORT BELVOIR, BLDG 1359
Project Number	:	DACA-31-89-C-0198
Fiscal Year	:	1991
Name of Analyst	:	EAC

****

KEY STUDY DATES

ECIP Economic Life	:	15 (years)

****

INVESTMENT COST SUMMARY

Construction cost	$	896
SIOH costs	$	49
Design costs	$	54
Energy credit calc	$	899
Salvage value cost	-$	0
Total investment cost	$	899

****

ANNUAL ENERGY SAVINGS(+) / COST(-), DOE REGION 3 , CENSUS REGION 3

Fuel	Unit Cost $/MBTU	Savings MBTU / Yr	Annual Savings $	Discount Factor	Discounted Savings
ELEC	6.07	0	0	8.78	0
DIST	0.00	0	0	12.34	0
RESID	9.97	25	244	12.05	2943
NAT G	0.00	0	0	12.48	0
COAL	0.00	0	0	10.01	0
TOTAL		25	244	$	2943

****

NON-ENERGY ANNUAL SAVINGS(+) / COST(-)

Item	Annual Savings $	Discount Factor	Discounted Savings
No cost items.			
Total discounted savings(+) / costs(-)		$	0

****

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Radiator Control Val — 09-26-91
Prepared By : E A C, PC BURKE, VA. — 60901891.00
E20-II Advanced Economic Analysis Program — Page 2 of 2
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NON-ENERGY ONE-TIME SAVINGS(+) / COST(-)

Item	One-Time Savings $	Year	Discount Factor	Discounted Savings
No cost items.				
Total discounted savings(+) / costs(-)				$ 0

****

DISCOUNTED NON-ENERGY SAVINGS(+) / COST(+) TOTALS

Non-energy annual savings	$ 0
Non-energy one-time savings	$ 0
Total non-energy savings	$ 0

****

PROJECT QUALIFICATION TESTS

Project non-energy qualification test.	
Energy savings calc	$ 971
Non-energy qualification not applicable.	
First year Dollar savings	$ 244
Total net discounted savings	$ 2943
Discounted savings ratio	3.27
Simple payback period (years)	3.68

****

ECO #2

CEILING INSULATION

BUILDING 1359

ECO #2 - Ceiling Insulation

Description - The existing heat loss/heat gain through the roof/ceiling assembly will be reduced by installing additional R-19 batt insulation above the seventh floor ceiling, improving the U-value from 0.22 to 0.0425 BTU/hr.- Sq. Ft. - °F.

Energy Saved	= 9 MBTU/year
Cost	= $530 (incl. SIOH)*
SIR	= 3.2

* The cost for this ECO has been developed from Means Cost Estimating Guide.

CONSTRUCTION COST ESTIMATE

Project: Energy Savings Opportunity Survey

Location: Control Tower
Building 1359
Fort Belvoir, VA

By: Engineering Applications Consultants

ECO: Add insulation above drop ceiling

ITEM	QUANTITY Number	Unit	LABOR Per unit	Total	MATERIAL Per unit	Total	TOTAL COST
Install R-19 insulation	676	sq. ft.	$0.17	$115	$0.39	$264	$379
SUB-TOTAL:				$115		$264	$379
Labor Markup: 21%				$24		---	$24
Taxes: 4.5%				---		$12	$12
SUB-TOTAL:				$139		$276	$415
Overhead: 10%				$14		$28	$41
SUB-TOTAL:				$153		$303	$456
Profit: 10%				$15		$30	$46
TOTAL:				$168		$333	$502

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Ceiling Insulation — 09-26-91
Prepared By : E A C, PC BURKE, VA. — 60901891.00
E20-II Advanced Economic Analysis Program — Page 1 of 2
LCCID - based (version 1, level 35).

****

STUDY IDENTIFICATION BLOCK

Project Title	:	ESOS
Installation Name	:	FORT BELVOIR, BLDG 1359
Project Number	:	DACA-31-89-C-0198
Fiscal Year	:	1991
Name of Analyst	:	EAC

****

KEY STUDY DATES

ECIP Economic Life	:	25 (years)

****

INVESTMENT COST SUMMARY

Construction cost	$	502
SIOH costs	$	28
Design costs	$	30
Energy credit calc	$	504
Salvage value cost	-$	0
Total investment cost	$	504

****

ANNUAL ENERGY SAVINGS(+) / COST(-), DOE REGION 3 , CENSUS REGION 3

Fuel	Unit Cost $/MBTU	Savings MBTU / Yr	Annual Savings $	Discount Factor	Discounted Savings
ELEC	6.07	2	12	11.37	131
DIST	0.00	0	0	17.06	0
RESID	9.97	7	66	16.85	1109
NAT G	0.00	0	0	17.52	0
COAL	0.00	0	0	13.34	0
TOTAL		9	77	$	1240

****

NON-ENERGY ANNUAL SAVINGS(+) / COST(-)

Item	Annual Savings $	Discount Factor	Discounted Savings
Demand Charges	31	11.65	361
Total discounted savings(+) / costs(-)		$	361

****

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Ceiling Insulation — 09-26-91
Prepared By : E A C, PC BURKE, VA. — 60901891.00
E20-II Advanced Economic Analysis Program — Page 2 of 2
LCCID - based (version 1, level 35).

****

NON-ENERGY ONE-TIME SAVINGS(+) / COST(-)

Item	One-Time Savings $	Year	Discount Factor	Discounted Savings
No cost items.				
Total discounted savings(+) / costs(-)			$	0

****

DISCOUNTED NON-ENERGY SAVINGS(+) / COST(+) TOTALS

Non-energy annual savings	$	361
Non-energy one-time savings	$	0
Total non-energy savings	$	361

****

PROJECT QUALIFICATION TESTS

Project non-energy qualification test.		
Energy savings calc	$	409
Non-energy qualification not applicable.		
First year Dollar savings	$	108
Total net discounted savings	$	1601
Discounted savings ratio		3.18
Simple payback period (years)		4.65

****

ECO #3

WEATHERSTRIPPING

BUILDING 1359

ECO #3 - Weatherstripping

Description - The building doors and windows are loose and have lost effective sealing. Weatherstripping will cut down on infiltration through them and will help in saving energy. This ECO requires weatherstripping all windows on the second through the sixth floor and on the exterior door to the mechanical equipment room door on the ground floor.

Energy Saved	= 21 MBTU/year
Cost	= $723 (incl. SIOH)*
SIR	= 1.7

* The cost for this ECO has been developed from Means Cost Estimating Guide.

CONSTRUCTION COST ESTIMATE

Project: Energy Savings Opportunity Survey

Location: Control Tower
Building 1359
Fort Belvoir, VA

By: Engineering Applications Consultants

ECO: Weatherstrip around windows
and first floor door

ITEM	QUANTITY Number	Unit	LABOR Per unit	LABOR Total	MATERIAL Per unit	MATERIAL Total	TOTAL COST
Weatherstrip around windows	12	each	$24	$288	$8	$96	$384
Weatherstip door	1	each	$65	$65	$37	$37	$102
SUB-TOTAL:				$353		$133	$486
Labor Markup: 21%				$74		---	$74
Taxes: 4.5%				---		$6	$6
SUB-TOTAL:				$427		$139	$566
Overhead: 10%				$43		$14	$57
SUB-TOTAL:				$470		$153	$623
Profit: 10%				$47		$15	$62
TOTAL:				$517		$168	$685

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Weatherstripping — 09-26-91
Prepared By : E A C, PC BURKE, VA. — 60901891.00
E20-II Advanced Economic Analysis Program — Page 1 of 2
LCCID - based (version 1, level 35).

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STUDY IDENTIFICATION BLOCK

Project Title	:	ESOS
Installation Name	:	FORT BELVOIR, BLDG 1359
Project Number	:	DACA-31-89-C-0198
Fiscal Year	:	1991
Name of Analyst	:	EAC

****

KEY STUDY DATES

ECIP Economic Life	:	5 (years)

****

INVESTMENT COST SUMMARY

Construction cost	$	685
SIOH costs	$	38
Design costs	$	0
Energy credit calc	$	651
Salvage value cost	-$	0
Total investment cost	$	651

****

ANNUAL ENERGY SAVINGS(+) / COST(-), DOE REGION 3 , CENSUS REGION 3

Fuel	Unit Cost $/MBTU	Savings MBTU / Yr	Annual Savings $	Discount Factor	Discounted Savings
ELEC	6.07	0	0	3.95	0
DIST	0.00	0	0	4.65	0
RESID	9.97	21	212	4.34	922
NAT G	0.00	0	0	4.47	0
COAL	0.00	0	0	4.27	0
TOTAL		21	212		$ 922

****

NON-ENERGY ANNUAL SAVINGS(+) / COST(-)

Item	Annual Savings $	Discount Factor	Discounted Savings
Demand Charges	51	4.10	209
Total discounted savings(+) / costs(-)			$ 209

****

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Weatherstripping 09-26-91
Prepared By : E A C, PC BURKE, VA. 60901891.00
E20-II Advanced Economic Analysis Program
LCCID - based (version 1, level 35).

****

NON-ENERGY ONE-TIME SAVINGS(+) / COST(-)

Item	One-Time Savings $	Year	Discount Factor	Discounted Savings
No cost items.				
Total discounted savings(+) / costs(-)				$ 0

****

DISCOUNTED NON-ENERGY SAVINGS(+) / COST(+) TOTALS

Non-energy annual savings	$	209
Non-energy one-time savings	$	0
Total non-energy savings	$	209

****

PROJECT QUALIFICATION TESTS

Project non-energy qualification test.		
Energy savings calc	$	304
Non-energy qualification not applicable.		
First year Dollar savings	$	263
Total net discounted savings	$	1131
Discounted savings ratio		1.74
Simple payback period (years)		2.47

****

ECO #4

NIGHT SET-BACK

BUILDING 1359

ECO #4 - Night Set-Back

Description - The building does not have any night set-back controls and, as such, wastes energy by maintaining the same comfort conditions during unoccupied hours as those during occupied periods. The controls will consist of a night set-back thermostat and a motorized damper in the outside air duct for the air handling unit on the sixth floor and the time clock controls for the fan coil units on the second through fifth floors.

Energy Saved	= 20 MBTU/year
Cost	= $1,188 (incl. SIOH) *
SIR	= 1.4

* The cost for this ECO has been developed from Means Cost Estimating Guide.

CONSTRUCTION COST ESTIMATE

Project: Energy Savings Opportunity Survey

Location: Control Tower
Building 1359
Fort Belvoir, VA

By: Engineering Applications Consultants

ECO: Install setback thermostats and
outside air damper control on AHU

ITEM	QUANTITY Number	Unit	LABOR Per unit	LABOR Total	MATERIAL Per unit	MATERIAL Total	TOTAL COST
Install setback thermostat	5	each	$24	$120	$64	$320	$440
Remove thermostat	5	each	$15	$75	---	---	$75
Motorized damper	1	each	$25	$25	$120	$120	$145
Interlock control	1	each	$25	$25	$167	$167	$192
SUB-TOTAL:				$245		$607	$852
Labor Markup: 21%				$51		---	$51
Taxes: 4.5%				---		$27	$27
SUB-TOTAL:				$296		$634	$931
Overhead: 10%				$30		$63	$93
SUB-TOTAL:				$326		$698	$1,024
Profit: 10%				$33		$70	$102
TOTAL:				$359		$768	$1,126

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Night Setback — 09-26-91
Prepared By : E A C, PC BURKE, VA. — 60901891.00
E20-II Advanced Economic Analysis Program — Page 1 of 2
LCCID - based (version 1, level 35).

****

STUDY IDENTIFICATION BLOCK

Project Title	:	ESOS
Installation Name	:	FORT BELVOIR, BLDG 1359
Project Number	:	DACA-31-89-C-0198
Fiscal Year	:	1991
Name of Analyst	:	EAC

****

KEY STUDY DATES

ECIP Economic Life	:	15 (years)

****

INVESTMENT COST SUMMARY

Construction cost	$	1126
SIOH costs	$	62
Design costs	$	68
Energy credit calc	$	1130
Salvage value cost	-$	0
Total investment cost	$	1130

****

ANNUAL ENERGY SAVINGS(+) / COST(-), DOE REGION 3 , CENSUS REGION 3

Fuel	Unit Cost $/MBTU	Savings MBTU / Yr	Annual Savings $	Discount Factor	Discounted Savings
ELEC	6.07	13	77	8.78	677
DIST	0.00	0	0	12.34	0
RESID	9.97	7	73	12.05	877
NAT G	0.00	0	0	12.48	0
COAL	0.00	0	0	10.01	0
TOTAL		20	150	$	1554

****

NON-ENERGY ANNUAL SAVINGS(+) / COST(-)

Item	Annual Savings $	Discount Factor	Discounted Savings
No cost items.			
Total discounted savings(+) / costs(-)		$	0

****

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Night Setback — 09-26-91
Prepared By : E A C, PC BURKE, VA. — 60901891.00
E20-II Advanced Economic Analysis Program — Page 2 of 2
LCCID - based (version 1, level 35).

****

NON-ENERGY ONE-TIME SAVINGS(+) / COST(-)

Item	One-Time Savings $	Year	Discount Factor	Discounted Savings
No cost items.				
Total discounted savings(+) / costs(-)			$	0

****

DISCOUNTED NON-ENERGY SAVINGS(+) / COST(+) TOTALS

Non-energy annual savings	$	0
Non-energy one-time savings	$	0
Total non-energy savings	$	0

****

PROJECT QUALIFICATION TESTS

Project non-energy qualification test.		
Energy savings calc	$	513
Non-energy qualification not applicable.		
First year Dollar savings	$	150
Total net discounted savings	$	1554
Discounted savings ratio		1.37
Simple payback period (years)		7.54

****

ECO #5

REFLECTORS

BUILDING 1359

ECO #5 - Reflectors

Description - There are three fluorescent light fixtures on the third floor which are open type fixtures. Reflectors for these fixtures will reduce both lighting and cooling costs.

Energy Saved	= 4 MBTU/year
Cost	= $768 (incl. SIOH)*
SIR	= 1.3

* The cost for this ECO has been developed from Mean Cost Estimating Guide and vendor quotes.

CONSTRUCTION COST ESTIMATE

Project: Energy Savings Opportunity Survey

Location: Control Tower
Building 1359
Fort Belvoir, VA

By: Engineering Applications Consultants

ECO: Install fluorescent fixture reflectors, third floor

ITEM	QUANTITY Number	Unit	LABOR Per unit	LABOR Total	MATERIAL Per unit	MATERIAL Total	TOTAL COST
Install reflectors	3	each	$75	$225	$105	$315	$540
SUB-TOTAL:				$225		$315	$540
Labor Markup: 21%				$47		---	$47
Taxes: 4.5%				---		$14	$14
SUB-TOTAL:				$272		$329	$601
Overhead: 10%				$27		$33	$60
SUB-TOTAL:				$299		$362	$662
Profit: 10%				$30		$36	$66
TOTAL:				$329		$398	$728

ENERGY CONSERVATION INVESTMENT PROGRAM REPORT

Discrete Portion : Reflectors — 09-26-91
Prepared By : E A C, PC BURKE, VA. — 60901891.00
E20-II Advanced Economic Analysis Program — Page 1 of 2
LCCID - based (version 1, level 35).

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STUDY IDENTIFICATION BLOCK

Project Title	:	ESOS
Installation Name	:	FORT BELVOIR, BLDG 1359
Project Number	:	DACA-31-89-C-0198
Fiscal Year	:	1991
Name of Analyst	:	EAC

****

KEY STUDY DATES

ECIP Economic Life	:	15 (years)

****

INVESTMENT COST SUMMARY

Construction cost	$	728
SIOH costs	$	40
Design costs	$	0
Energy credit calc	$	691
Salvage value cost	-$	0
Total investment cost	$	691

****

ANNUAL ENERGY SAVINGS(+) / COST(-), DOE REGION 3 , CENSUS REGION 3

Fuel	Unit Cost $/MBTU	Savings MBTU / Yr	Annual Savings $	Discount Factor	Discounted Savings
ELEC	6.07	6	38	8.78	336
DIST	0.00	0	0	12.34	0
RESID	9.97	-2	-20	12.05	-240
NAT G	0.00	0	0	12.48	0
COAL	0.00	0	0	10.01	0
TOTAL		4	18	$	95

****

NON-ENERGY ANNUAL SAVINGS(+) / COST(-)

Item	Annual Savings $	Discount Factor	Discounted Savings
Demand Charges	93	9.11	847
Total discounted savings(+) / costs(-)		$	847

****

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NON-ENERGY ONE-TIME SAVINGS(+) / COST(-)

Item	One-Time Savings $	Year	Discount Factor	Discounted Savings
No cost items.				
Total discounted savings(+) / costs(-)			$	0

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DISCOUNTED NON-ENERGY SAVINGS(+) / COST(+) TOTALS

Non-energy annual savings	$	847
Non-energy one-time savings	$	0
Total non-energy savings	$	847

****

PROJECT QUALIFICATION TESTS

Project non-energy qualification test.		
Energy savings calc	$	32
Non-energy savings-to-investment ratio		0.18
(SIR < 1) Project does not qualify.		
First year Dollar savings	$	111
Total net discounted savings	$	943
Discounted savings ratio		1.36
Simple payback period (years)		6.21

****

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT BELVOIR REGION NO. 3 PROJECT NUMBER DACA-31-89-C-0198

PROJECT TITLE: ENERGY SAVINGS OPPORTUNITY SURVEY FISCAL YR. 1991

DISCRETE PORTION NAME BUILDING 1359 - TOTAL ALL ECO's

ANALYSIS DATE AUGUST 1991 ECONOMIC LIFE _____ YEARS PREPARED BY EAC

1. INVESTMENT
   - A. CONSTRUCTION COST $ 3,937
   - B. SIOH $ 217
   - C. DESIGN COST $ 151
   - D. SALVAGE VALUE - $ _____
   - E. TOTAL INVESTMENT (1A + 1B + 1C - 1D) $ 4,305

2. ENERGY SAVINGS (+) / COST (-)
   ANALYSIS DATE ANNUAL SAVINGS, UNIT COST AND DISCOUNTED SAVINGS

	FUEL	COST $/MBTU/YR(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A.	ELEC	$ 6.07	21	$ _____	_____	$ _____
B.	DIST	$ 7.43	_____	$ _____	_____	$ _____
C.	RESID	$ 9.97	58	$ _____	_____	$ _____
D.	NG	$ 5.33	_____	$ _____	_____	$ _____
E.	COAL	$ _____	_____	$ _____	_____	$ _____
F.	TOTAL		79	$ 701		$ 6,754

3. NONENERGY SAVINGS (+) / COST (-)
   - A. ANNUAL RECURRING (+/-) $ 175
     - (1) DISCOUNT FACTOR (TABLE A) _____
     - (2) DISCOUNTED SAVING/COST (3A X 3A1) $ 1,417
   - B. NONRECURRING SAVINGS (+) / COST (-)

ITEM		SAVINGS (+) COST (-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
(1)	_____	$ _____	_____	_____	$ _____
(2)	_____	$ _____	_____	_____	$ _____
(3)	_____	$ _____	_____	_____	$ _____
(4)	TOTAL $ _____				$ _____

   - C. TOTAL NONENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) $ _____
   - D. PROJECT NONENERGY QUALIFICATION TEST
     - (1) 25% MAX NONENERGY CALC (2F5 x .33) $ _____
       - a. IF 3D1 IS = OR > 3C GO TO ITEM 4
       - b. IF 3D1 IS < 3C CALC S1R = (2F5+3D1) - 1E = _____
       - c. IF 3D1 IS = > 1 GO TO ITEM 4
       - D. IF 3D1 IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3 + 3A + (3B1d - YEARS ECONOMIC LIFE) $ 876

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 8,171

6. DISCOUNTED SAVINGS RATION (IF < 1 PROJECT DOES NOT QUALIFY) (S1R) = (5-1E) = 1.9